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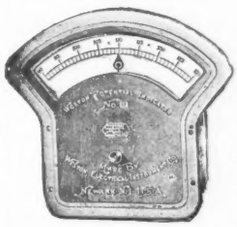

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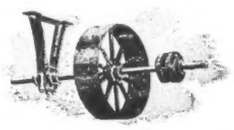

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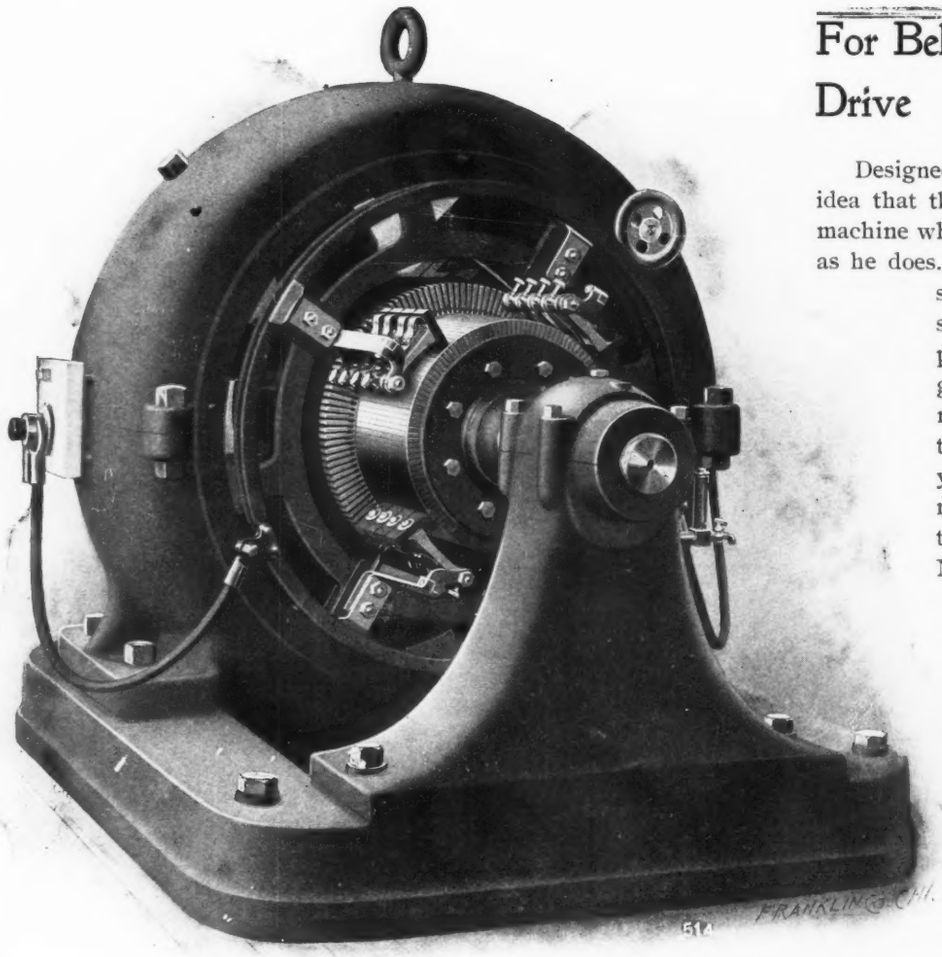

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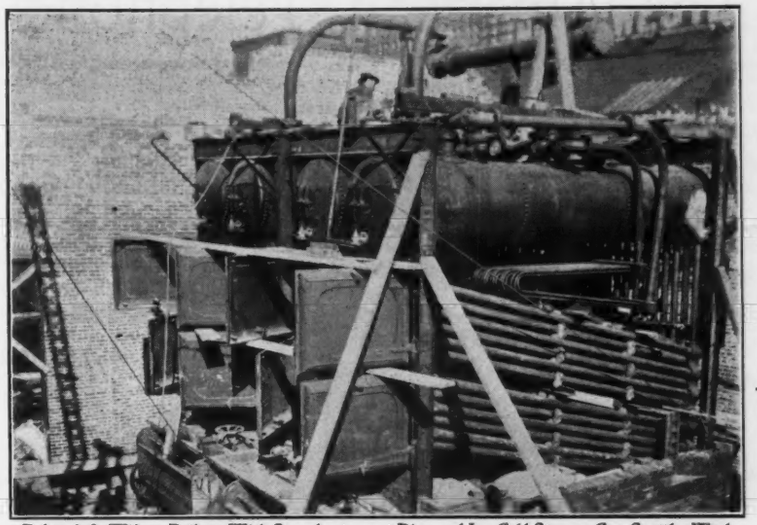

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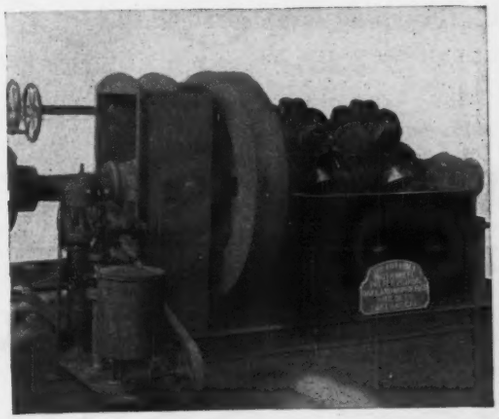

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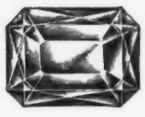
TRADE  MARK

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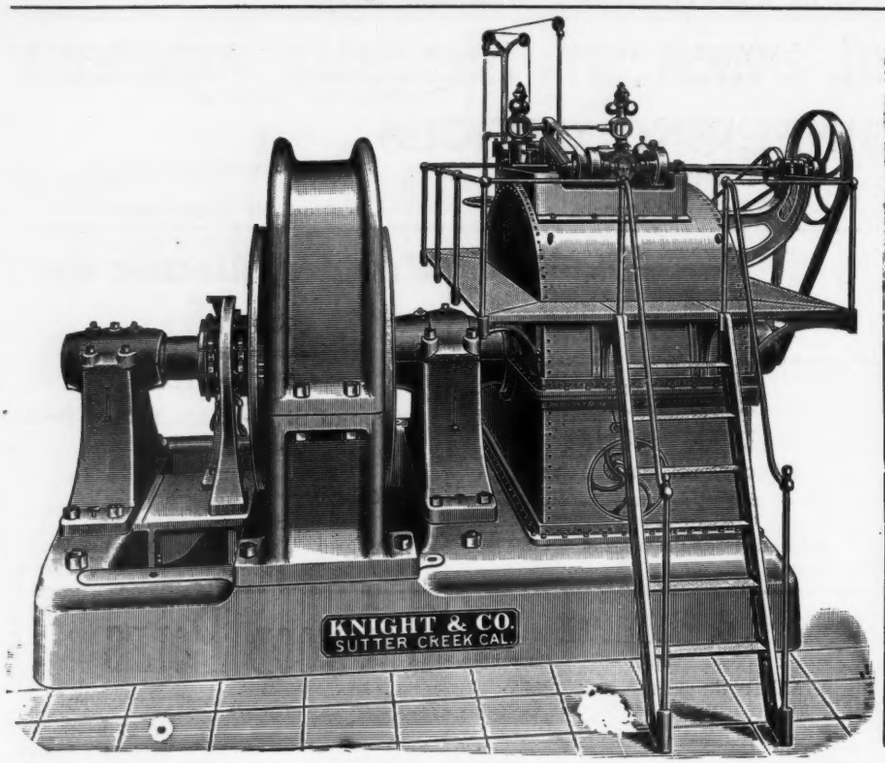

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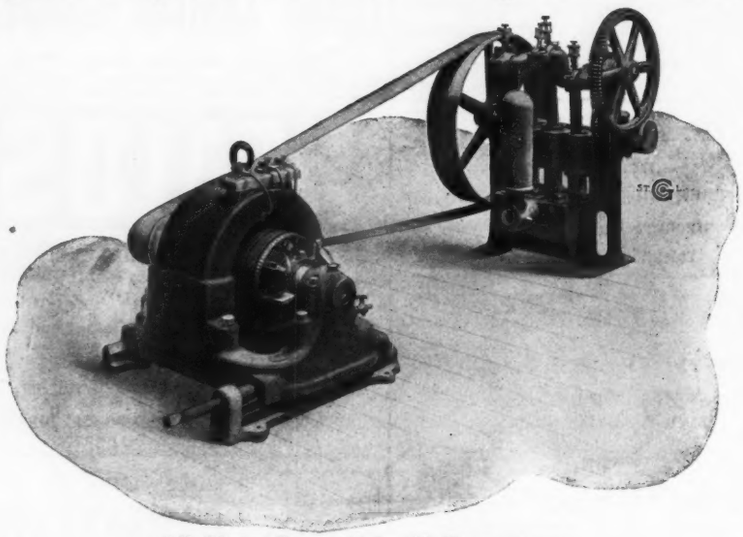

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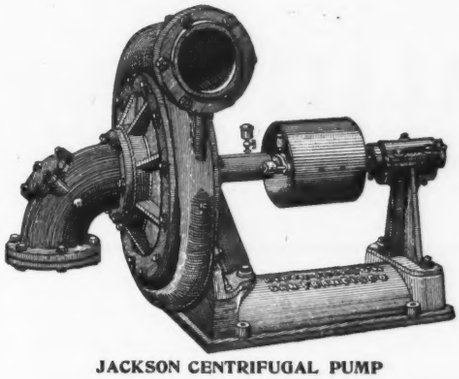

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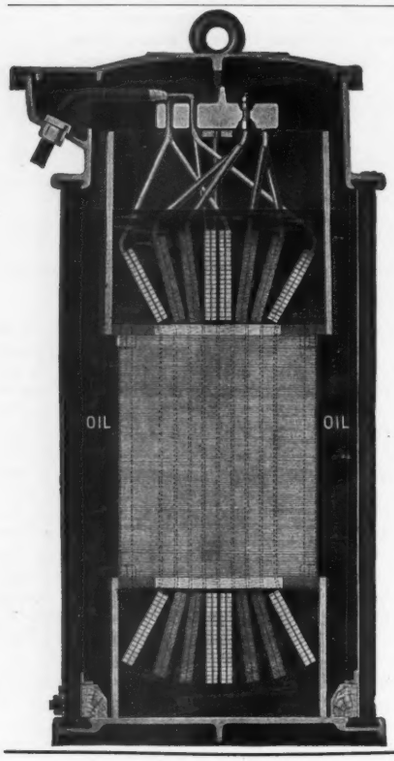

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VOLUME XII. SAN FRANCISCO, NOVEMBER, 1902. NUMBER 11

The Pacific Coast Gas Association.

Some of the Invaluable Papers Read Before Its Tenth Annual Meeting, San Francisco, July 15-16, 1902.

AFTER reviewing at some length the various papers and subjects brought up for discussion during the previous annual meetings, Mr. C. E. Burrows, of Walla Walla, Wash., retiring president of the Pacific Coast Gas Association, reminded the attendants to its recent tenth annual meeting that on July 11, 1893, there was assembled in the directors' room of the San Francisco Gas Light Company, in San Francisco, a number of earnest men who had responded to a call issued by Mr. J. B. Crockett, president, and Mr. E. C. Jones, engineer, of the San Francisco Gas Light Company. The men who so assembled recognized the value of association, and with very little of formality and no friction they organized the Pacific Coast Gas Association. Fifty-four names appear as charter members; forty-one of these came from twenty-five gas companies and thirteen names represented various allied industries.

"The nine years which have passed since then have been eventful ones in the gas industry," continued Mr. Burrows in his presidential address, "for the business has advanced with wonderful strides, and it has formed associations that nine years ago would have been deemed improbable if not impossible. The mingling of the gas and electric interests, like the confluence of two rivers, has gathered force and power from the union, and now these two great interests are practically one; not that we as members of the Pacific Coast Gas Association are any the less 'gas men,' but we have in a measure become 'electrified.'" While the use of the electric current has been immensely extended by reason of the development of the great water powers which abound in the Pacific Coast States, the gas business has not remained idle. Improved devices for using gas for illumination have been a great stimulus, and the advantage of the gas stove for cooking seems to be fully appreciated. According to information furnished by the managers replying to my recent inquiries, the last year's business shows a net increase in sales of gas for illuminating of 24 per cent., and for cooking and heating 36.88 per cent. The extremes of per cent. are: Increase for lighting, 3 per cent. and 100 per cent.; and for cooking gas, 7 per cent. and 100 per cent. Surely this shows a healthy condition of the gas business in this jurisdiction.

"At the last annual meeting of the Pacific Coast Gas Association a proposition was put forth that was at once recognized as of much importance, namely, the establishing of a library and headquarters for gas men. A committee was appointed to take the matter in hand, and the report of that committee will inform this meeting of the progress made. The start, thanks to E. C. Jones and L. P. Lowe, was an auspicious one, and we will do well to follow it up with the proper spirit. In this connection I beg to call your attention to that part of Past President Britton's address, in which he suggests the formation of an advisory board, to which the members of the association could apply from time to time during the year for advice, etc. I trust this may be fully considered when you have the report of the library committee before you. In my experience there have been occasions when I would have been glad to submit questions to such a board, and probably others have been similarly situated.

"Some two years ago acetylene gas was something of a bugbear to some of us, but today I am not aware that any gas company is suffering from that kind of competition. The Welsbach people and some others have put on the market gasoline lamps that give a very fine light. We can scarcely find fault with people who take the risk and use them; still they are by no means in general use, and, so far as my observation goes, are not materially hurting the gas business. High pressure distribution of gas has claimed much attention in the gas journals during the past year. I trust some of our members may give us some valuable hints on this very interesting subject. 'Gas Advertising' will be discussed in a paper by R. P. Valentine, of Sacramento. It is a fruitful subject and liable to draw out a greater variety of opinions than almost any other matter connected with the gas industry. 'Municipal Ownership' will be handled in a paper by Frank J. Symmes, of San Francisco. I believe no one has proposed a paper on the 'Promoter,' a species of humanity who has often annoyed managers of gas and electric plants. He is frequently around, and asking for a franchise in the interest of the good people, and if successful is usually ready to treat with the established company for a consideration. An adequate remedy for raids of this character would, in my opinion, be the enactment of suitable laws providing for gas and electric commissions in our several States. I am a believer

in State control, to a just extent, of quasi-public corporations. If a majority of our members are of similar mind, I think we should take some action on the subject; perhaps by appointing a committee to consider the matter and report at our next annual meeting. We would be more likely to obtain just legislation than if left to some anti-corporation cranks. You can be sure we shall not long be let alone. Another subject that has received large attention in the recent past is 'Differential Rates for Gas Supply.' Our worthy vice-president, M. C. Osborn, will illuminate our minds on this question, and as it has two sides you are expected to ventilate it thoroughly. We are all interested in the 'Fuel Conditions in California,' and other coast States. John L. Howard will entertain you on this subject. An experiment on the 'Principles of Purification,' by E. C. Jones; 'Electrically Operated Appliances in Gas and Electric Works,' by George C. Holberton, and 'The Recognition of the Engineer, with Especial Reference to Gas Engineering,' by L. P. Lowe, are in waiting for your consideration. These, with a lecture by P. W. Tompkins, of San Francisco, on 'The Method of Determining Water and Sediment in Crude California Petroleum,' constitute a fund of information and studies seldom surpassed in societies of this character in either quantity or quality, and of which I bespeak your closest attention."

MUNICIPAL OWNERSHIP.*

BY FRANK J. SYMMES.

AN ever recurring question before the American municipality is, "Who shall own and operate the so-called public utilities?" If it becomes settled as to one utility, a new one comes into the field. How may people secure, at the lowest price and of the best quality, those first essentials to life and comfort—water, light and transportation; for these are the first utilities which demand a settlement, and they are promptly followed by others of less importance, but equally effective for political purposes. Any service to the people which requires the use of the public street becomes a public interest and justifies a reasonable public control; first, the necessity, afterwards the luxury. From the growth of a community to that of a village comes, first, the demand for a common water distribution, then follow the gas pipes, car tracks, electric wires for light and telephone service, and at last appear pipes for steam transmission. Although not generally known in many American cities, steam is now conveyed from central stations through the public streets for house warming and for power purposes, and it is safe to predict that within a reasonable time we may transmit a cooling medium in the same manner. The ice man will lose his importance and be largely displaced. The citizen, by turning a valve, will "cool off" his refrigerator much as he now heats up his radiator, and by means of these same pipes the atmosphere of his residence may be cooled at will.

In this development of the town or city the man or corporation who first brings these utilities within the citizens' reach is regarded as a public benefactor. Later the citizen regards such enjoyments as his prerogatives, claims the right of control, and at last condemns them to public ownership. Private capital was ready to invest in these utilities before the city or town was prepared to assume them, and, as an encouragement to the private investors, an aid to "infant industry," first franchises have often been granted without compensation. In time the privileges increase in value, the street becomes occupied by other utilities, the public is incommoded in its street travel, the private corporation is criticised and condemned and public antagonism is aroused against it. The municipality seeks control by legislation, and unscrupulous legislators either attempt to "get even" on the monopoly or to "cinch" it for private gain. When agitation over these questions becomes frequent and violent, prejudices are aroused and good government is disturbed. Amid the controversies bad blood is stirred, political issues are made over them, the private corporation is charged with bribery and corruption, and the remedy claimed is public ownership. Any fair sized city, not yet the proud possessor of its water or gas works, not yet having tasted the experience of public ownership of a great utility, thinks it "must have them." Like the Pears' soap baby in the bathtub reaching out for the soap cake, it can't be happy till it gets it. In time, however, the city discovers that municipal administration is not well adapted to this kind of responsibility, and after financial waste, extravagance and political corruption the utility becomes run down and neglected, so the last step is to lease the public utility back to private management where business methods and honest administration can prevail.

Cities and towns are to be found in this country today, in all the various stages of this experience, suffering from private ownership and from public ownership, and the last stages of their troubles are often worse than their first.

There is something very attractive about this public utility cry. It appeals to many classes of men. The capitalist knows he can make money out of it, the politician thinks he ought to; if honest he would make it for the public, if dishonest he would make it for himself. For the socialist it serves as a text for all his theories, for the demagogue it proves his best political capital.

The capitalist knows from experience that he can conduct the business affairs of the great gas, water or railroad company far more economically than the public official can, and that the difference is a handsome profit. He knows that the properties increase in value with the city's growth, that the business itself increases, and that with the advancement comes a diminished rate of expense. He knows that no other investment is safer and surer of its income if it be permitted to enjoy the natural profits which should come of it, and, notwithstanding the uncertainties of legislation and municipal control, he still remains faithful to it. All these investments under good management rank up next to the bonds of the National Government.

The public utility is also equally attractive to the politician and to the office holder. It gives them fine opportunities to become conspicuous and to appear important. It offers many places to be filled, much money to be handled, fine opportunities for honorable distinction, and still greater and finer ones for plunder. It gives to the corner groceryman, whose acquaintance with the affairs of these institutions has been restricted to a payment of $1.50 a month, a glorious chance to says how these great properties, involving ten, twenty or fifty millions of dollars, should be handled. The office holders, present and prospective, may be counted upon to advocate public ownership. They may advocate public ownership with a view to saving to the people the profit of the private corporation, and the possibility of securing such a result is a justifiable ambition and just stimulant to the aspiration; but, too often, alas! it is supported from other motives.

To the demagogue the public utility comes as a glorious blessing. It serves for his chief political thunder; it is his greatest stock in trade. He holds it up as the greatest public enemy, continually threatening the welfare of the people—the most wicked of trusts. It is the red rag with which he may rouse the socialistic bull, incite the ire of the crazy anarchist, and by it whip their votes into line. It is for him a beautiful hobby upon which to ride to glory—and to a higher office.

To the plain, honest citizen the public utility is a large and complicated piece of machinery necessary for the use of the people. It is to convey to him an abundance of pure water from the distant springs or reservoirs of nature, to manufacture and deliver to him a good quality of artificial light, to provide the best

*A paper read before the Tenth Annual Meeting of the Pacific Coast Gas Association, San Francisco, July 15-16, 1902.

possible facilities for travel about the public streets, and to do all these and other things at a reasonable cost. He realizes that, whether this is done for him by the wicked corporation or by the extravagant municipality, he is too often an unnecessary sufferer. He knows that any change may be but the shifting from one to the other horn of his dilemma, and he knows further that he is not always so great a sufferer as he is told.

What is expected of the wise citizen is that he should not be misled by the wild cry of the politicians whose palms are itching for plunder—for such there are; that he should ignore the rapacious cravings of the wicked corporation and the greedy capitalists—for such there are; and that he should be uninfluenced by the high ambitions and the virulent attacks of the demagogue—for such there are; and that he should see for himself fairly, judge calmly, discern truth and demand justice clearly, and then to stand by them firmly and persistently. If he would do all this he should heed the Chinese maxim, "Hear both sides and all will be clear; hear one side and you will still be in the dark." He will find the public utility question a very practical one, and there is more to be learned from the experience of others than from the most extended study of its theoretics.

He must, therefore, seek his information from all sides. He must study the most successful examples and ascertain the causes of their success; he must investigate the greatest failures and discover the reasons for failure. He may find both success and failure under the same system, but he must discover the reasons for both.

He will find in the public mind two radical and extreme views upon the subject, with a growing tendency toward public ownership. He will find good and wise men presenting strong arguments that the State has no right to take up any business that the private citizen can perform, and he will find other men who believe that the Government should perform them all, an extreme of socialism reaching to complete paternalism. As usual, reason and good judgment will be found along the broad, middle path. This sensible man will waive all preconceived ideas, discard all prejudices, and judge the facts free from bias of every kind. If he is seeking after truth he will not endeavor to make out a case. He will not magnify or exaggerate the advantages of one side, nor ignore nor avoid them on the other. He will avoid the methods of the attorney to bend every advantage to his side, to smuggle in all that can help his case and seek to rule out all that can injure it. He will not play upon the pride, the passions, the prejudices of others, or yield to such qualities himself. There is no criminal to be saved from the gallows at any cost. He will act the part of judge and jury; he will deal only in justice, fairness and truth.

He will find this question clearly a business one, not complicated by religious, philanthropic or charitable considerations, entangled only by political ones. He must seek to free it from these. The public utility cannot succeed anywhere unless it can be honestly and efficiently conducted, and wherever it fails under public ownership politics is the cause of it. It becomes a moral question only to the extent that any good business transaction is a moral question, that it is a practical application of true ethics, and demanding a careful discrimination between right and wrong. It is only thus far that we can go in our demands upon our public servants or upon the private corporations. It is of no consequence to us whether our officials are "High Church" or "Low," "Catholic" or "Protestant," and we need not know whether they are Republican, Democratic, Prohibition or Socialist, so that they are faithful, honest and efficient, conducting their public duties well.

The true value of the public utility lies in the management, not in the ownership. Whoever can operate these institutions so as best to serve the public need is the owner of the public wants, and is entitled "to have." Whoever can furnish the necessities of life so that the poor may obtain the most for their slender means may be considered the proper owner. If the State can perform this service better than any other the State should undertake it; if, on the other hand, the State attempts it and fails, it should return to private control.

The question is, can the street car accommodations, the telephone service, the light, the water, aye, the milk and the bread, be furnished to the people through the city government better and cheaper than through private enterprise? It matters not to the consumer where the title to the property lies, who owns the car tracks, the telephone wires, the water pipes or the milk cans. It is good car and telephone service, good light and water, milk and bread, at the lowest rates which the consumer needs and is entitled to have. It matters not to him whether the water comes from Lake Tahoe or Lake Chabot, or whether the street car in which he rides bears the name of the "United Railways" or is emblazoned with the great seal of San Francisco, so that he obtains the best possible service at the lowest possible price. We must not be diverted from this point. Results we want, not methods. Municipal ownership and management may be far better than private ownership; it may be far worse. We want the best.

If we would gain from other's experience we must ascertain how the work has been conducted elsewhere; but when we come to study other situations we must be careful not to be deceived by them, for each situation has its own special conditions. San Francisco or Oakland should not be misled by what may have been successfully done in London, Glasgow or Kalamazoo. Each city has conditions distinctly its own, so probably no precise parallel could be found. London has cheap gas, for there coal is cheap—only one-third the price it is here; Glasgow has cheap water, for there the rainfall is sixty inches in a year, and in that ancient city a sunny day is a curiosity. The streets are never sprinkled; less than thirty days' water storage is required. Here we have a long dry season, are liable to a succession of dry years, and a three-years storage system is required.

The advocates of public ownership can point out many cities where great and wonderful benefits have been derived from that system, while the other side may offset it with an equal number of instances of glaring robbery and political corruption under the same system. Individual examples are of little value unless the conditions are the same, and many examples even may prove misleading.

Mr. Carroll D. Wright, the United States Commissioner of Labor, recently issued his fourteenth annual report, treating entirely of water, gas and electric light plants. In it are 975 pages of tabulated statistics, concerning 2353 institutions, not quite one-third of the total number in the United States, and 42 per cent. of these are under municipal ownership. The reports are most elaborate and carefully classified, yet a full investigation of this volume fails to satisfy any positive claim on behalf of either side. The commissioner cautions the reader against a "careless comparison of the various plants." The varying conditions are such that a complete knowledge of each must be had in order to form a fair judgment. All the facts go to prove that it is not a question at all of who owns the plants, but as to what are the varying conditions and how the plants are conducted.

Some years ago there lived in New York city a well known wit whose name was Travers. He was afflicted with an unfortunate stammer. After a short time of residence in the great metropolis he was met by an old friend from his former city, who ventured to remark that his stammer seemed to be worse than when he lived in Baltimore, whereupon Travers replied, "Y-y-e-s; b-b-b-igger city." There are many other things which grow worse as the city grows bigger.

Public ownership finds its severest test in the big cities, and its greatest successes are always found in the smaller places. Good public management is best acquired when the city is young. The bigger the city the "b—bigger" the undertaking of acquiring the utilities, the "b—bigger" the risk in management, the "b—bigger" the waste, the "b—bigger" the chances of corruption, and the "b—bigger" the opportunity to hide a fraud from the people.

In the small city or town the public official is ever before the public eye. He realizes his responsibility, and his public pride and patriotism are stimulated by contact with his fellowmen. He becomes known to the people; he realizes his duty to his neighbor

and his friend and he lives up to it. The bigger the city the further the public eye becomes removed, the weaker becomes its vision, and the more easily it is blinded. Responsibility to a great number weakens the tie, and civic pride and patriotism waste and disappear.

In an address upon this subject before the Merchants' Association, Professor Babcock declared that whilst the Croton water works had not escaped its share of the political corruption, extravagance and mismanagement from which New York city had suffered, its management had been regarded as "generally satisfactory." And yet, within two weeks from that time, the Merchants' Association of New York published a "report showing discrepancies in city revenues," in which it was shown that for a term of twelve years, covering the period of its expert's examination, there was an actual deficiency in the city's returns from the Croton water works of $4.107,372. The value of the metered water reported by the chief engineer during this time was $11,346,-162. During the same period the Registrar, through whose office the collections were made, accounted for but $7,138,790, which sum not only included the amount of his collections, but the amount yet due the city and returned by him as arrears. A great number of the meters were never read; presumably those used by the friends of the administration. This number of unread meters increased steadily in the twelve years investigated from thirty-five to 1577 in number, and the discrepancy between the revenue due from the quantity of water reported by the engineer as having passed the meters, and the revenue actually accounted for by the Registrar, ranged from $271,000, as the smallest deficiency, to $477,000, as the largest deficiency for a single year during the period of investigation.

In nearly every case of the so-called successful public ownership—as in the case of the Croton water works just quoted and the well known instance of the Philadelphia gas works—only a part of the story is told, only a part of the expense account is admitted, and the bookkeeping is juggled in nearly every instance in order to give an apparent profit. A common example given of a fine system of public ownership and managment is the National postoffice department, and yet old Californians can recall how, when the first Government rate of postage was 3 cents, we were glad to pay Wells-Fargo 5 cents for a better service, out of which sum received by them they paid 3 cents to the Government, and then performed the better service for the remaining sum—two-thirds the Government rate.

The instances of economical and efficient management of common business transactions by city, State or National governments are rare, and when the contracts are let out to private parties evidences of fraud are continually reported.

When we are told that the city can manage these utilities better, and are given alluring pictures of how much can be saved to the people, we must not be misled by the seductive allurements of first figures. Every man knows that he cannot possibly foresee the end in a great enterprise. Few men can build a house, or indulge in any scheme, even under their own best management, and come out according to the first estimates.

Under city management the situation is far more uncertain, and we must look at great municipal ventures with exceeding caution. We are in the position of the little girl who, hiding behind her father's chair and trembling with fear at a big mastiff, was told by her father not to be frightened; for did she not perceive that the dog was wagging his tail? "Yes," she replied, "I see his tail go; but that is not the end I was afraid of."

We judge what people can do and what they are likely to do by what they have done, not by that which they say they can do. Let me cite just one instance of what San Francisco has done. The city built a city hall. On April 4, 1870, the Legislature passed an enabling act providing for the sale of the city hall lots in Yerba Buena Park, and for the construction of a new city hall at at cost not to exceed $1,500,000, the building to be erected and completed within three years of the passage of the act. Everything looked serene and the mastiff wagged his tail good naturedly. The building was turned over to the city July 1, 1899; not in three years, but after more than twenty-nine years, and the mastiff had bitten us to the tune of $5,723,987, nearly four times the estimated cost. Can we do any better if we undertake a twenty or thirty million dollar enterprise now? And there are no better business men nor more upright and honorable gentlemen now than most of those who served for twenty-nine years on that City Hall Commission. Is it not better, then, to bear the trifling ills we have, from the great utilities in their present hands, than to fly to those far greater ones that we know not of? It is the "other end we should be afraid of."

Our neighboring city of Santa Rosa wanted its own water works, and by special election in 1893 voted to issue $165,000 in bonds for the construction of the same. Bids were called for and two were submitted; one for $164,500, another for $161,000. It afterwards proved there was collusion between the bidders, and the successful bidder was to sublet the job to the other for a sum "not to exceed $129,000." The courts were called in, the bonds were declared void by the Supreme Court, and new ordinances and bonds were issued. There was continuous litigation. The City Council repeatedly changed the plans, always in favor of the contractor, to the extent of $9000. The pumps had to be altered and moved at an expense of $4600. The Council released the contractor from his forfeit, and returned to him his deposit check for $10,000. The reservoir cracked and leaked when the water was turned in, and extras were granted to the amount of $1286, covering work which was in the original specifications.

On January 2, 1896, the Council hastily accepted the works, to preclude the filing of suits to prevent. At this time the private water works had 1050 connections. The city attempted to supply 650 of these, but failed, and during the first ten months became a customer of the old company to the extent of nearly $1200.

The judgment of the Supreme Court was that the original contract was null and void, and the city absolved from all liabilities; that the bonds were unlawfully and fraudulently disposed of, and that the Mayor, Council, Treasurer and contractors were liable in the sum of $165,701.25. It was decreed that an accounting should be had of the actual value of the works and the judgment entered against the officers and contractors for the difference between a proper valuation and the sum of $165,701.25.

Judge Dangerfield, presiding in the case, found that the works could probably have been built for $79,000, but were worth much less on account of faulty construction. A jury, however, was found that was able to value the works at $190,000; but "the other end" in Santa Rosa is not yet, for a suit for $100,000 damages against the city has quite recently been entered by the old company.

The good city of Boston, Mass., yielded recently to the seductive wagging of the mastiff's tail, and attempted many reforms in the direction of municipal ownership. She established bureaus of stationary and printing, carpenter work, electrical construction and repairs, and even an ice plant for cutting and storing ice for the drinking fountains. It was the highest ideal of municipal ownership ever attempted in America, and established under a Mayor of unquestioned character and ability. It took but two years to discover "the other end" in Boston, and when the mastiff was unloosened from his grip the city found that her ice had cost $60 a ton, when the ordinary rate was from $2 to $3, and that every one of her bureaus was costing her from 25 per cent. to 50 per cent. more for their results than if she had depended upon private ownership. There was no embezzlement, no charges of genuine dishonesty; only natural municipal waste and extravagonce. The new Mayor asked the head of a bureau to tell him how many men could be spared without any harm to the efficiency of his bureau. The next day he brought a list covering one-third of his force. The bureaus have been closed down, and the estimated saving in the first six months was between $500,000 and $600,000.

It may be noted that among the various public enterprises water works have more often escaped mismanagement, but the

example of New York is now prominent before us, and St. Louis and Cincinnati cannot count upon continued safety is this department if all the rest of the government is bad. Men are not corrupt and dishonest six days in the week and entirely virtuous and upright on the seventh. Neither will political thieves permit the water works to escape their attention indefinitely if they already operate in the other branches of the city government.

About the best instance of efficient public ownership and mismanagement that I have been able to find is that of the Boston subways, a series of tunnels made for the purpose of relieving the congestion from street car traffic upon the street surface. The city was authorized to issue bonds for the purpose of its construction. The Governor of the State appointed a commission of five members for five-year terms, at a salary of $500 each. The estimate made in 1804 upon the subways proposed was $5,000,000, and the net cost, when in operation in 1899, was but $4,141,896. The first year's traffic showed 50,000,000 passengers carried at a rate of between seven and eight miles per hour, while the surface travel had been but two miles per hour, and the income from the railway company leasing the tunnel will pay the interest and sinking fund to the extent that, when the bonds expire, principal and interest will be paid and the city will own the subway without the actual investment of a dollar. This is an ideal example of good public service, but it reflects upon the ability and good judgment of the Governor and his commission and not upon a city management or contract. There seems no good reason why the people should not have many other instances of such management.

In Europe public ownership of these utilities has proven a success in the great majority of instances, but the conditions are in nearly every case found vastly different from ours.

No fair minded man can ignore the fact that public ownership has in many places proved a complete success, but it never occurs without honest management, good technical skill and the best of civil service. If one is tempted to quote many cases of unsuccessful public ownership and find not all of their successes, let us remember that it is the bogs and pitfalls only we have to fear, not the smooth easy paths; that it is the seductive apple, the alluring woman, the tempting office and the wicked corporation. All of these we must learn to stand up against. We need not concern ourselves over our virtues, they will take care of themselves; our faults are what we must strive to correct.

No State in the Union has less need for public ownership of these properties than California, for she has the best kind of control. Our Constitution requires the Supervisors to set the price which the private utilities may collect for their water and their light. If the people are not well served it is the fault of the public officials who make the price. This is far better than ownership.

If the retail merchant could walk into the wholesale warehouse and name the price which he should pay for his goods; if he could declare the wholesaler's profit he would never invest his own capital in order to carry a stock. Would he not be too glad to escape all the risks of ownership? Let me but make the price on the articles I buy and I care not who may own the stock.

No matter how complete has been the success of public ownership in many cases, may we not conclude, from the sad experience of those who are glad to recede from it, from the fact that California already has the chief advantages without the risk, and from the fact that we have not yet learned to conduct our present affairs economically and well, that public ownership here may properly and wisely be postponed and certainly most carefully considered.

I am not so sure of the conditions in other cities on the coast, but I do know that now, in San Francisco, the city is not badly oppressed by the private corporations, and not in a position to perform the work better. She needs other things much more. She needs better schools, streets and sewers. She needs a more generous public spirit and a more harmonious action amongst her citizens. She undoubtedly needs some kind of treatment—to go on a milk diet, perhaps—the milk of human kindness. We need to stop finding fault with each other and to make the best of things. We need to work together for good, and the newspapers should work together to help us. We are not half as bad as we make ourselves appear. Officials are not all corrupt and corporations are not all thieves. Every good deed helps us and helps the city, though it be but a little at a time; and every selfish and unfair act and every unnecessary advertising of our sins hurts our city; perhaps but a little at a time, but an injury all the same.

A full and fair investigation will show that gas, water, telephone, telegraph and railroad companies can almost invariably be conducted more economically and more efficiently under private than public ownership. But we are told that in the case of the private ownership the profit goes to the corporation and but a limited number are benefitted, whilst all the people are contributors. Under public ownership this profit would be equally or proportionately divided with all the people; assuming always that the efficiency would remain the same. But under public ownership we find a great municipal waste which may more than offset it, hence it becomes a question of corporate profit versus municipal extravagance. If corporate profit is reasonable there might be no just grounds for a change; if municipal waste can be reduced to a minimum there may be many and good reasons for the public ownership. As it is, economical public service can seldom be found, and never in this country be counted upon, and private management, if under public control, seems the wiser plan. The question is for the municipalities to first secure a wise and honest administration of their present affairs, after which and in due time all of these things may be safely added unto them, to prove themselves faithful over the few things that they may become proper rulers over many things.

The whole question resolves to a matter of men. It is the kind of man which tells the story for good or evil in the world, whether he be in public office or private corporation. Men of noble character will not rob the people, whether they occupy a chair in the city government or command the powers of a great monopoly. Here as everywhere comes the cry, then, for men of high and pure character. If great and good things are to be performed great and good men are needed to perform them. It is "the man behind the gun" who determines the range, the direction and the result of his shot, and it is the man behind the office who is to determine for us whether public or private ownership is the better. And until we can secure equally good men for public as for the private office, the private corporation has the advantage.

If I owned San Francisco, and had unlimited credit, I would not think of buying out or assuming the care or expense of the public utilities. The public is not oppressed by them, and they are already under control. There are seventy millions already invested in these enterprises, and I would take the benefit of it. If I took it away from them, much of that capital would disappear from the city. I would sit with these wicked people in a fair and honorable spirit, determine between us what would be just rates to insure them 5 per cent. income on their investment, and agree upon a rate for twenty years. I wovld stop "nagging" them and let them alone.

I would borrow a hundred million dollars and start in to make San Francisco what it should be—one of the largest and most beautiful cities on the globe. I would spend five millions on the water front, and invite the ships of the world to come to us. I would have the streets so fine and clean that even Paris would come to see and enjoy them. I would have every pipe and wire carried in open tunnels beneath the sidewalks, and the streets should be undisturbed. I would have trees and plants and flowers to beautify the city in every direction, until it became one of the "show places" of the world.

In the year 1900, 240,000 people crossed from this country to Europe; four-fifths of them were Americans going abroad to spend money. They spent there not less than $200,000,000. Inside of ten years I would have half of them coming this way. Inside of twenty years I would have 100,000 American visitors and 50,000 foreigners. If they spent $200 apiece I would have $30,000,000 a

year income from them alone. San Francisco should show her pace, and the population and its business would double in two decades.

When the Almighty excavated this wonderful bay he provided dock and harbor facilities for 10,000 vessels, and He expected us to build and use them. When He surrounded it with those beautiful hills He looked down upon them and beheld that they were good. He did not expect us to tear them away and slice them up. He expected that we would know enough to preserve and beautify them, else they would have been given to Chicago or New Orleans, where the people would pay $100,000,000 apiece for them. When a generous Providence fed our bay by the bounteous rivers flowing from our magnificent mountains through the richest and most fertile of valleys, it was believed that we would learn to utilize these waters and not permit them to go to waste and destruction. When He gave to California (and to no other people on earth) the redwood of the coast, and the sequoia of the Sierra, which with omnipotent power required from 1000 to 7000 years in construction, it was expected there would be a wise and intelligent people here to care for and enjoy them. When we were given the vine and fig tree, the orange, lemon and olive, fruit, flowers and grain enough for ourselves and half a world besides, it was expected that we would become a happy and industrious people upon this wonderful garden spot. It was surely fitted for the wisest and best people on earth.

California should endeavor to live up to those expectations. We should justify this wonderful heritage, and whether the people own the water, gas and railroad properties, or only control them, is of little consequence if we can only learn to live together in peace and harmony, enjoying the blessings we have and bringing blessings to each other, with hand or heart turned against no man, and with charity to all and malice toward none. Doing these things we shall find it easy to build up great and beautiful cities for a happy and prosperous people.

FUEL CONDITIONS IN CALIFORNIA.*

BY JOHN L. HOWARD.

IT is said to be an evidence of advancing years when an individual contracts the habit of mentally dwelling in the past. The strenuous life of every man of business activity is so filled with problems respecting the present and the future that but little time remains for retrospection, as well of individuals as of lines of trade, is full of interest and of lessons for guidance.

Before touching upon present fuel conditions, a backward glance may be found profitable, because the history of the fuel trade affords many illustrations that the general law of the survival of the fittest has always been operative, sometimes because the fittest article was the best, sometimes because it was the cheapest, and at times it combined both of these attractive qualities. The fuel trade of California covers a period of about forty years, and there are still men actively engaged in it whose experience runs back over the entire time. The evolution and the changes are probably best reflected in the statistical tables which, while far from accurate, yet approximate the truth close enough for the purpose of this paper.

Evidences of coal deposit exist relatively near the coast, and throughout the entire length of the State of California, and although during all the years of its progress these deposits have been known, yet at only two points have the developments been pushed to yield an appreciable volume of business.

The older movement, in what is known as the Mount Diablo fields, made its first development in 1861, with a total output of 6600 tons. The output multiplied until the maximum product reached 200,000 tons in 1874. Since that time the business has regularly and rapidly declined, until successive abandonments have caused, for commercial purposes at least, a cessation of all shipments. The coal is a low lignite of a low order, heavily charged with sulphur. It rapidly decrepitates on exposure. It is liable to ignite spontaneously of short storage, and is of low evaporative power. Its production within thirty miles of San Francisco, and its relative cheapness in the days when it was free from competition, caused it to be both popular and profitable, but as soon as it faced the better grades, brought in quantities from the north and from abroad, its star waned, the quality and the cost of mining did not fit it to survive, and Mount Diablo coal has now become a matter of history, of statistics and of memory.

The later movement in the Corral Hollow region, south of the Mount Diablo field, is ill-starred, and it may be dismissed with the brief statement that it was born too late. The quality is quite similar to the Mount Diablo coal, and the decline in the popularity of that product should have deterred the projectors from embarking in the newer scheme. It was launched at the time when the changed conditions of trade made success impossible. Long before, the poorer grades to which that class of coal belonged had given way to the better qualities, because these were cheaper, and this large coal investment, now but little used, is a monument of of sad but persistent self-deception.

San Francisco was always the large consuming market, and the high prices obtainable in satisfying its needs caused a general search along the coast for new and better sources of supply; so, during the early sixties, the discovery of lignite deposits at Coos Bay, in southwestern Oregon, led to the establishment of various coal mining enterprises, all of which save one have been abandoned. The output has never been an important factor, and it found its way into use as a cheap fuel, although commercially it is the lowest in grade of the domestic coals.

Almost simultaneously with the movements at Coos Bay were those connected with the lignite deposits at Bellingham Bay, and near Seattle, on Puget Sound. These, while proving to be the best of lignites, have been largely displaced for domestic use and almost entirely for steam generating purposes. The Bellingham Bay mines were closed more than twenty years ago, and the demand for the Seattle lignites is a constantly increasing one. Indeed, the present increasing difficulty of disposing of the waste product known as lignite screenings is rapidly raising the question as to whether that class of coals may continue to be sold at a profit. But by far the most important factors in the trade during the past twenty years have been the coals from British Columbia and from Great Britain and her colonies. This latter trade was the direct outgrowth of the export business in grain from California.

Grain freights outward attracted to our coast vessels from all parts of the world, and especially from distant coal shipping points. So great did this attraction prove that at one period 50 per cent. of all our export grain was carried away in ships that had brought coal cargoes from abroad; this percentage, however, declined, in 1891, to about 25 per cent.

Coal importations reached their height from Australia, with 408,000 tons in 1889, and from Great Britain, with 235,000 tons in 1892. Since those years there have been fluctuations in the quantities, but a marked decline has taken place, for the statistical exhibit of 1901 shows that Australia sent us only 175,000 tons and Great Britain only 52,000 tons. Present conditions seem to point out that this decrease will be progressive, and that ultimately the volume of these importations will become merely nominal.

Before dismissing this phase of the subject let me refer to one or two theories that may have interest for this meeting, because they have been creditably received in our State. One theory has given rise to the expression that "The farmer pays the freight." This means that, taking the prices for grain that are current in European markets where California wheat is sold, if the rate of water transportation be deducted the result will be approximately the value of the wheat at the home shipping port. The farmer, therefore, needs a plentiful supply of vessel tonnage to compete for the carriage of his grain, because that naturally means lower rates of freight and correspondingly higher values for his products. Therefore, whatever tends to diminish the supply of competing tonnage is theoretically inimical to the farming interests.

It has happened that while in 1889 Australia sent us in wheat carrying ships 408,000 tons of coal, Vancouver Island delivered

*A paper read before the Tenth Annual Meeting of the Pacific Coast Gas Association, San Francisco, July 15-16, 1902.

418,000 tons and Washington 372,000 tons, while in 1901 importations from Australia had sunk to 176,000 tons and Vancouver Island advanced to 710,000 tons, while Washington reached 674,000 tons, clearly showing that these two adjacent sources of supply have been absorbing not only the loss made by Great Britain and Australia, but also the natural increase in the demand of the State.

Now the coal from the north is not carried in vessels that relieve our grain markets, and if the displacement of distant foreign coal should make our port less attractive to foreign ships and diminish the tonnage seeking our products, one would naturally expect to see a corresponding rise in grain rates, and thus bring about an added oppression to unprofitable business in growing cereals.

As a matter of fact grain rates outward have at times been lowest during periods of relatively small coal importations, and at present they rule at about 26 to 28 shillings per ton, which is far from an abnormally high condition.

It is difficult to establish a theory that will long fit the changing conditions of trade. Only the inexorable law of supply and demand is unchanging, and that law has been operative in this particular line of business. The tramp steamer has been constantly encroaching on routes that were thought secured to sailing ships. England has ceased building sail tonnage, but France has taken her place in order that her capital may avail itself of her profitable bounty laws, and there seems to be tonnage in quantity to satisfy our needs. But attention is called to a local movement which is said to be in operation, and described as a concert of action among wheat exporters, to prevent violent and abnormal fluctuations in grain charters due to the keen competition that has hitherto existed.

An attempt has been made to excite the prejudice of the unthinking against the movement, but if it does extend, and if there be any truth in the theory that the farmer pays the freight, then this movement cannot be but beneficial to him, for in its practical result there is no difference between reasonable freight rates caused by the prevention of unhealthy competition between the people that buy and ship the wheat.

The other theory, and one that had especial interest for this membership, was that the cost of imported coal was in the inverse ratio of outward wheat freights. This meant that when grain freight rates outward were high, or promised to be so, shipowners would rush their vessels to our ports, especially with coal, upon which the rates of carriage were forced downward, thus placing the farmer who wanted low freights and the coal consumer who wanted cheap coal at opposite ends of a business "see-saw."

There have been so many exceptions to this that it has never been a safe working hypothesis. Today outward grain charters are made at 26 to 28 shillings, while coal has recently been shipped from England and Australia at the surprisingly low freight of $1.92 per ton, nearly as low as it might be freighted from Puget Sound, and at about one-third the cost of freighting coal from the Atlantic seaboard.

The problems of the past no longer command the keen interest of members of this association, some of whom have paid $15 per ton, at San Francisco, for Australian gas coal, and 1¼ cents per pound for shale in order to add one to two candle power to their product. They seem to have found their day of deliverance when anthracite coal and California petroleum became readily available.

Before leaving the past it may be well to note that, according to the statistical tables, high water mark in the coal consumption of California was reached in 1900, with receipts of 1,900,000 tons. A little more than one-third of this was supplied from Vancouver Island, about one-third from Washington, the balance from all other sources.

One of the most noticeable of the declines has been in the importation of anthracite coal from Wales. In 1895 the receipts were 151,000 tons; in 1901 they fell to only one-quarter of that amount.

Its large use was owing chiefly to its economy and freedom from smoke as a steam fuel. Its smaller use is due to the substitution of petroleum, which, in point of steady cost per unit and in efficiency, has outclassed its popular predecessor. I think it is safe to say that for steam purposes oil has entirely supplanted anthracite coal.

Its only present use is in the manufacture of water gas. In the early days of its importation California was able to obtain cargoes of the higher grades of this coal, because the British and Continental demand for anthracite was far below the power to supply it. I remember visiting, in 1896, a showroom on Regent Street, London, where various types of stoves were kept running to advertise the superiority for domestic use of the hard over the softer coals, very much as our friends the gas companies display the advantages of gas over coal as a household fuel.

Then the process of change was slow, but now the British demand is largely absorbing the British anthracite product, and points on the Continent hitherto supplied by Wales are furnished with anthracite from America.

As a rule, however, only the softer grades of anthracite have been shipped to California, whose buyers considered merely the generic term of Welsh anthracite, and the price per ton, without much regard for quality. The names of popular brands have been used to conceal many mysterious mixtures, and at present there is en route to San Francisco a cargo composed of fifteen different varieties, gathered from the four quarters of Wales, in order to minimize the loss on a perilous contract.

The decrease in the importation of distant foreign coals may be understood with a brief explanation. The bases of supply were from three to six months distant from point of time. The price was inconstant. Influences operated to affect both the cost of coals and of freight. These facts necessitated the carriage of large stocks at San Francisco, or the assumption by the merchants of undue risks in the matter of contracts.

Twenty years ago and earlier it was the practice to bring to the coast clipper and merchandise sailing ships that had lost their ratings in the merchant service. In 1882 the current freight on coal from Puget Sound was $3.50 per ton. Today some of the same ships are carrying coal at $1.75 per ton. The introduction of steam colliers has caused this decline, and on the time charters of some steamers the cost of freighting has been as low as $1 per ton. The use of steamers became possible only with another change that took place. In earlier days the cumbersome, tedious and expensive method was employed of discharging coal from one hatch, at the rate of 100 tons per day, into a portable hopper on a wharf, and the hauling by teams to an open yard where the coal was piled at great expense.

Now you may see the discharge from five hatches simultaneously at the rate of 3000 tons per day, and the movement of the coal by cars on elevated trestles into coal bunkers, and the use of the gravity principle in the storage and delivery.

It was the nearness to mines, the fixedness of cost, both of production and of freight, and the easy maintenance of stocks, that enabled the northern coal producers to absorb to a large extent the trade which otherwise might have gone to the distant foreign coals. But, as I shall mention later on, there is the need on the part of the coal trade to apply in its own interest another lesson that has been set for it by its competitors, but which it has been slow to appreciate and still slower to use.

Approaching the present conditions, I well remember, at the earlier meetings of this association, when the note of alarm was sounded at the threatened incoming and the possibilities of electricity as a factor in the lighting business, and the expressions of real or affected unconcern under the belief that gas was invincible.

Later I detected a change in sentiment from one of indifference to that of the need of self-protection. This was as against steam made current, but later on the original small cloud expanded when scientific progress revived and lessened the conceived difficulties respecting long distance transmission; then came the final change. Every stream issuing from the western slope of the Sierras has been exploited, and is provided with a power plant either in fact or on paper. If any water course has escaped its days of liberty are few.

Are there many gas companies in the State that, when threatened with current from the mountains, were not ready to meet the new-

comer at the city limits and become its retail merchant? With what relief the contract that averted danger was put away along with the boldness of front that was assumed during the negotiations. Were all of them able to withstand the pressure from without under the policy of absorption and concentration?

Compare the ownership represented in your association and its first meeting with the condition of today, and say whether you could have conceived or believed the revolution that has since taken place.

Outside San Francisco the lighting business of the State is in a comparatively few hands, and it can be supposed that the present chaotic conditions in this city are interminable. All is in darkness in the local lighting business.

Fifty-cent gas is profitless, and, long indulged in, will lead to business suicide. New wire and pipe line projects pointed toward San Francisco are in the minds of men.

Sooner or later a set of men must come to the front to take hold of the present unsatisfactory situation, and whether the reasons or causes for it be revenge, or the levying of tribute, or the attempt at invasion, or the resentment at intrusion, they will all be disposed of; then stability of rates and values, with confidence and profit, will be restored.

The competition of electricity was not an evil unmixed with good, in so far as the gas business was concerned, for out of this have come the ingenious and persistent efforts to increase the use of gas as a household fuel. Efforts whose success can be measured only by the number of gas stoves now in use, and by the increasing proportion of the daily output of gas that is consumed for purposes other than illumination. Efforts which are making themselves sensibly felt in the proselyting of domestic coal consumers.

In the fuel markets of the State, electricity as yet has not been a large disturbing factor, nor for power purposes has gas worked any important changes; but not so with the latest applicant for the fuel business, because petroleum has literally absorbed the steam plants on land, and has begun its career of conquest on the water.

The great impetus given to the development of the oil bearing fields resulted in a combined productive capacity far in excess of market necessities. Four barrels of oil are offered to satisfy two barrels of demand, and in consequence prices have been forced to the limit of little or no profit. The current rates arise out of no necessity to compete with coal, because the point of equivalent values was long since reached and passed in the downward rush of oil prices. The maintenance of unremunerative oil rates arises out of the internal strife among the producers. In some instances because under-capitalized companies must meet current expenses by forcing sales of their products. In other cases production is kept up in the hopes of an early turn in the tide. In others there is the aggressive absorption of business at low rates and for long periods, with the expectation that recalcitrant producers may be forced into a movement ultimately intended to enhance the market value of oil, but which is not yet so all embracing as to promise success. Meanwhile the non-producing capital fills its tanks with the oil of the needy producer, and the consuming patrons enjoy the prospects of an indefinite continuance of cheap fuel.

A word here about what may be called a variable "rule of thumb" that is much quoted in the trade parlance regarding the relative values of oil and coal as fuels. Currency is given to the statement that three barrels of oil equal one ton of coal. This is quite untrue and misleading; but as it has reference to the evaporative efficiency of the two fuels, it must be apparent that the relation depends upon the quality of the coal with which the comparison is made.

After examining a large amount of data collected from sources that may be regarded as reliable, and covering a long period of time, I think it may be safely assumed that the average experience shows the net evaporative effect to be 13.5 pounds of water per pound of oil. There is abundant evidence to prove the correctness of the following statement of evaporative efficiencies:

Welsh anthracite coal	11.5	pounds water
Cardiff coal	10.5	"
Australian steam coal	9.5	pounds water
Washington steam coal	7.5	"
Washington lignite coal	6.5	"
California lignite coal	4.5	"

Each steam plant is a law unto itself. Money results are too important to be determined by bald and unsupported assertions, and if the fuel consumer has had regard for the keeping of reliable data, that fact will make him entirely independent of the statements of over zealous vendors of coal. My observation is that the average experience will show an economy of about 33 per cent. in the use of oil as compared with coal for steam fuel. The oil problem seems to be a mixed one, and attempts at forcasting are surrounded with difficulty.

Abundant capital in the hands of a mammoth concern that has the ability to buy and to pipe the oil would seem to make competition impossible for those who must use rail lines and market their product in the same field or for the same uses.

The prospect for this is leading to the development of oil bearing fields near the ocean and the piping of oil for transportation by water. To the extent that crude oil may be piped or carried in vessels the rail lines will lose business, but the cheapening of cost at terminals will afford no relief to the over supply; the result of that will be the absorption of trade by those that are most favored. Necessity is forcing the conversion of oil into other forms of value, notably by distillation. Eastern railroads are dissatisfied with its use on their railroads and have abandoned the experiment; the same will probably be the experience here. It will find a limited field for laying the dust on country roads, but I imagine that its largest use will come from a geographical extension of its markets, both by rail and by water.

Oil depots will be established at points along our coast, both to the north and to the south of us. It has been successfully introduced as far as Hawaii. Many years since the writer visited Europe to look into the possibility of introducing anthracite coal from the Atlantic seaboard. The then costs of the coal and of the water transport made the project impracticable. Today under changed conditions anthracite coal from Pennsylvania is shipped to the continent. Now the demand for oil seems to be geographically restricted, but who shall say that within a few years it may not be successfully transported to the Orient.

In this hurried review it will have been noticed that the fuel trade has had its varied experiences, from the wood used by the original settlers, through the various grades of coal from the poorer lignites, the semi-bituminous, the bituminous to the anthracites, and in turn it is now facing the combined attacks of electricity, gas and petroleum, with this one lesson unlearned and unapplied. It has left to it only the domestic coal business; its competitors deal directly with the consuming public, while the coal producer is content to perpetuate the "Fall of '49 and Spring of '50" methods which interpose between himself and the public large intermediate interest that increases the cost of his product for the consumer from 30 to 40 per cent. His business has thus become an easy mark, and to save the remnant of his trade there is the imperative need of economies in all directions, to the end that his coal product may be furnished to the consumer at the lowest cost consistent with reasonable profit.

The query is, "How will he face this problem?"

THE RISE AND RECOGNITION OF THE ENGINEER.*

BY LEON P. LOWE.

To the thinking and observing mind it must be apparent, indeed for many years past it must have been particularly so, that revolutionary changes are taking place in the government and control of the affairs of the world. For centuries past the supremacy of nations has depended largely upon their physical power and ability to destroy, and in the endeavor to maintain this physical supremacy has the effort, skill and financial

*A paper read before the Tenth Annual Meeting of the Pacific Coast Gas Association, San Francisco, July 15–16, 1902.

ability of nations been principally directed, until humanity has been burdened to the last extreme in the endeavor to support the tremendous armies and navies of the world.

These warlike creations, originally organized for purposes of defense, have grown to such stupendous proportions that in many instances their maintenance has been the cause of the wrecking and undoing of the various institutions which they were intended to defend and preserve, their supposed blessings having thus proven evils in disguise by developing within themselves their own destruction.

But these have not been the only evils suffered because of the possession of these giants of destruction, far greater ones lying in the opportunity of oppression afforded by the possession of powerful armies and navies, ever ready to obey the command of excuse where that of reason does not prevail, until the pages of history have been blackened and blood stained with the wars of revenge, the wars of conquest, and the wars of injustice and extermination which have been waged and waged by the powerful against their weak and often defenseless adversaries.

This unfortunate condition of affairs must maintain as long as people are willing to preserve these vast institutions of menace; but already the voice of humanity is raised against the outrages of the past, and gradually the world is beginning to awaken and listen to the cry of reason and justice by recognizing the necessity of the peaceful arbitration of all matters of difference, be they between nations or individuals, and when this much to be desired condition is attained necessity for the soldier will have practically disappeared.

But we must not decry the good which the warrior has done, nor be unmindful of his heroic service in the past, and, indeed, those which he may unfortunately be yet called upon to render, and wonderment cannot, therefore, be expressed at the hero worship so unstintingly bestowed upon the soldier, our past and even present court of last resort; but gradually the praise formerly bestowed upon the chieftains of old, who won their battles through sheer force of physical strength, endurance and valor, has been transferred to the warrior who fights with his brain, until today we find the once despised physical pigmy, with his modern development of frontal bone, the recognized superior and leader in his profession, the warrior of the past having given place to the warrior engineer of the present, and who, in turn, will give precedence to the engineer of the future.

Distasteful as it may be, one may see, by the momentary lifting of the veil, the ponderous battleship, upon which countless wealth has been expended, at the complete mercy of the submarine boat, costing only a handful of coin, and the present land defenses made useless by the coming airship.

The past, however, has not been wholly without its engineers, as is amply proven by the surviving evidences of the magnificent works of the ancients, some of which show skill even in part surpassing that of the present, and which we are pleased to style the "lost arts," though which in the name of justice should be referred to as the destroyed arts, the slow, laborious, painstaking work of the engineers of old having for centuries given way to the destructive force of the warrior; but little by little, step by step, ant-like in his persistency, has the engineer made the inhabitants of the world so interdependent and necessary to each others comfort and happiness, that the light of reason is beginning to dawn, scales are falling from eyes, and the time is not far distant when the world will demand in no uncertain voice the cessation of destruction and the preservation and upbuilding of the useful arts, and then will the engineer and his co-workers, the chemist and physicist, be supreme.

Today the government of the world may be said to rest in the hands of the statesman and politician, the statesman being supposedly of the greater assistance to mankind and better fitted to govern because of his studious attention to the wants and needs of others.

Theoretically there should be no politicians, but they exist and are today viewed more in the light of birds of prey of greater or less legitimacy, by sufferance allowed to exist as possibly occupying the stepping stone to statesmanship, but as the value of the services of the engineer receives recognition, and his knowledge of the legislative needs of the people become more apparent, he will be called upon to take his place in the moulding of the affairs of State, and with his advent politicians will lose their power and statesmen become more profound.

The greatest advancement of the world has been that of the nineteenth century, and if one were to name the arts which have done most for the marvelous progress and development during that period the palm would in justice be awarded to chemistry and philosophy, but as both sciences are largely theoretical, and call for the close and studious application of their devotees, the vigorous and practical application of the engineer has been required to fully develop their value. As time rolls on the necessary alliance of the chemist and engineer is more apparent, ample demonstration of this fact being found in the increasing number of published works dealing with the chemistry of engineering.

In the foregoing the meaning of the word "engineer" has been dealt with in its fullest and broadest sense, though it is well known that there are many fields of engineering of varying importance, each quite distinct and accepted as different professions, though not entirely separate, as all branches are more or less allied and interdependent. That branch known as gas engineering is the one intended to be specifically dealt with herein, and of all the engineering professions none other calls for such a general and diversified knowledge of the others as does gas engineering, and probably none is of greater importance, dealing as it does with all important and momentous questions of light, fuel and power, that of fuel ranking first among the scientific and mechanical problems of the day.

To those familiar with the conditions of the gas industry of today as compared with that of a quarter of a century ago, the contrast cannot be but most marked. Then artificial gas was practically of but one kind—coal gas—and its use was limited almost solely to lighting, though it is true that gas companies were then pointing proudly to the suitability of their product for use in nursery burners, or for other domestic purposes of not much greater importance. The gas engine was then an unheard of prime mover, and the gas engineer shared similar fame, although it cannot be denied there were good and progressive gas men in those days. but they unfortunately, by force of circumstances, were working in the deep rut so plainly grooved by their predecessors, and with but small desire to break away from the traditions and teachings of the early investigators in the gas world.

To remark this condition more forcibly, one has only to refer to the gas literature of the past, either as published in the technical journals of the day or in the proceedings of gas associations, and to compare the state of the art as it then existed with that of the present. No competitor, other than the ill-smelling kerosene lamp and the poorly made tallow dip, shared the field with the luxurious gas jet, the concern of the gas manager being shown but slightly in the disposal of his main product—gas—he deeming it of more importance to find a field for his coke, tar and ammonia, the gas looking after itself, for, commanding the field as it did, it was a question of "take it or leave it" in its most autocratic sense.

It is true that some few far-sighted engineers and managers of those days urged the importance of improvement and the reaching out and into new and unexplored fields for the extension of their business, but the average gas man paid only small heed to the so regarded "optimistic cranks" who sought to lead him into channels new, and there is no telling how long he would have drifted on in the good, old way had not his electrical competitor, in truth a blessing in disguise, forced upon him the realization of doing something, whatever it might be, and for actual self-preservation he turned to the field of gaseous fuel with all its promise and neglected possibilities. But to make even a beginning in this field required ability, courage and tact, and a knowledge but little possessed by your then average gas man, and there is no telling

(*Continued on page 218.*)

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EDITORIAL

THE TRANSFORMER HAZARD.

For some time past great uneasiness has been felt in fire insurance circles concerning what is known to underwriters as "the electrical transformer hazard," and it was with the view of restricting this hazard, together with mollifying the conception of its seriousness under proper conditions of installation, that a paper* was presented, by invitation, before the last annual meeting of the Fire Underwriters' Association of the Pacific. It was not that the transformer itself was regarded as being especially hazardous, so much as it was that the presence of oil in large quantities in an electric station constituted an element of risk which was aggravated by the fact that the possibility of the burning out of coils, sometimes with explosive violence, increased the danger to a degree far beyond that presented by the mere storage of oil. The solution the problem presented is one which must inevitably affect electric station interests to a material degree, for if does not lend an influence toward changing the design of station buildings, it will at least increase the cost of insurance, and in so doing enhance an already heavy item of fixed charges.

The tendency of the day in fire underwriting is toward the exclusion of oil-filled transformers in large sizes of every description from electric stations, and toward requiring that they be placed in separate fire-proof buildings. In general this constitutes good practice, especially in building new stations, but there does not appear to be warrant for making the banishment of large oil-filled transformers from stations a universal rule. Constant current arc lighting transformers, for instance, might well form a notable exception to the rule, as there are many reasons for their exemption, the chief ones being their self-regulating features and the safeguards precluding the possibility of their being overloaded. And as for the incendiary proclivities of constant current arc transformers, all of them in the West combined could hardly equal the hazard possessed by a single arc light dynamo of the now fast becoming extinct open circuit armature type. Let good judgment prevail in the tabooing process and all will be well.

If a general definition be asked concerning the class of transformers which might be well relegated into separate fire-proof buildings apart from power houses, it might be said to the advantage of electrical and insurance interests alike, that this class embodies all large high tension transformers which are connected to pole line circuits, or transformers which are so connected to other transformers that, in event of trouble to one transformer, the energy of other transformers, or of the generating station, can be centered in it, furthering its destruction. This definition may appear abstruse to the layman underwriter, but let him remember by way of explanation that the generators in the power house all work together in the common cause of furnishing power to the line, as perfectly as though they were builded into a single dynamo of colossal proportions. Let it be remembered, too, that all the energy or power of this array of dynamos stands ready to respond to any demand for power which may be made upon the line, and when it is remembered further that the line is incapable of distinguishing demands for power for legitimate operations, such as driving street cars, from demands for power for destructive operations, such as burning out transformer coils, it will be seen how readily the entire energy of the power house can be centered in the destruction of a single substation transformer. Of course, safeguards in the way of fusing high tension lines may afford some degree of protection from this predicament, but high tension fuses at best are of liberal proportions, for what is the cost of a burned out transformer in comparison to the annoyance of an unreliable service?

The short circuiting of a high tension transmission line and the burning out of a substation transformer are two troubles which are ordinarily indistinguishable to the the operator in charge of the generating station. Once in a while, during the rare occasions when troubles arise, he can distinguish a characteristic which will indicate the source of the disturbance, but generally he is all at sea, he knows that trouble exists somewhere, the telephone service has "gone out of business" promptly on the appearance of the trouble, and the station operator, assuming that that ever most vulnerable point—the transmission line—is again in difficulty, will perhaps raise the voltage up to the highest limit after the manner of low tension underground practice, in the endeavor to "burn out the short on the line."

*"The Transformer Hazard," by Geo. P. Low. Published in abstract in THE JOURNAL, Volume XII, page 159, August, 1902.

If he does this, perhaps the trouble is not on the line. Perhaps it is a high tension arc in a substation, or may be a transformer burn-out at the flour mills. The man at the power house does not know where it is, and it is prudent that he should, even in a figurative sense, pour oil on the flames by raising the voltage to burn out a line short which he supposes to exist. No one can or will object to the burning out of a line short, if line short it be; but to burn out a substation in lieu of a line short may some day become a reality if greater discernment is not effected in locating the source of transmission line troubles.

But to revert to the oil transformer and its hazards; it is not going too far to say that the most perfect appliance in all the category of electrical machinery is this self-same transformer. Its efficiency is extraordinarily high, it practically eliminates the element of physical hazard from electric shock to transmission station attendants, it is at once the vital substance in the root, trunk and branch of the great development of transmission practice, it gives most supple flexibility to transmission engineering, which owes its very being to the transformer. As for its drawbacks, they are but few and very, very far between; indeed, in its generic form it has no drawbacks of any consequence, for it has at last been demonstrated that oil-filled station transformers—those quondam genii of evil in the minds of fire underwriters—are really the most trustworthy, the most reliable, even the most phœnix-like of all modern electrical station equipment. When properly installed they will go through a station fire more nearly unscathed than any other piece of electrical apparatus—and that is saying a great deal in their favor.

To particularize: A fire occurred in Montana last month destroying the entire plant of the Helena Light and Traction Company, as well as considerable electrical property of the Missouri River Power Company, whose superlative generating station and transmission system formed the subject of the leading article in THE JOURNAL for June, last. Four years ago the Helena company began to take power from the Canyon Ferry plant of the Missouri River Power Company, over an 11,000-volt line some eighteen miles in length. After securing this power the Helena Light and Traction Company shut down its steam plant, and since then it has been gradually modernizing its system until at the time of the fire the station contained, in addition to six 150-kilowatt, 11,000-volt transformers belonging to the Missouri River Power Company, a sufficient assortment of oil-filled transformers to enable a close study to be made upon their behavior in time of serious fire. A detailed description of the fire, with illustrations, will appear in the next issue of THE JOURNAL, but suffice it to say that the building was completely gutted, and the loss to the electrical machinery and the entire contents of the station was apparently total. From behind the ruins of the marble switchboard were resurrected three oil-filled regulators which cost $900. They were found to be in perfect condition, except for leads and handles, which $20 will replace. Then three Hartford constant current arc lighting transformers of the oil-filled type were removed from the ruins, the "emulsion" was pumped from them, the cores and coils were overhauled, and five days later they resumed their regular duty of lighting the streets of the city of Helena. The cost of their cleaning was approximately 25 per cent. of their original cost, the great bulk of the damage being to their controller panels and to the loss of the oil which was rendered unfit for use. The six 150-kilowatt high tension transformers, however, were not nearly so fortunate, for they were erected on a wooden floor which burned through, dropping four of them into a pit into which they poured barrel after barrel of mineral seal oil. That made a fire worthy of hades, but nevertheless the coils of the two transformers which remained upright were not materially injured, except by water (the transformers were overloaded and their covers had been removed to facilitate cooling), for the oil protected them. Had these six transformers remained in an upright position, and had their covers not been removed, their coils would have suffered no injury.

What, then, can be done to bring about the practical elimination of the hazard of oil-filled transformers. Simply this: erect them on a foundation as solid as those built for engines; equip them with water coils for cooling, and feed these water coils from an exterior source of supply; place them in heavy wrought iron cases, so covered with heavy caps as to be water tight, and then if you choose to do so (it will be a further desirable precaution) place them in a separate building. Above all, keep them off of wooden floors and out of buildings which, when burning, will upset them and pour out their oil. This done, fire underwriters will soon learn by experience that that which these columns have uttered in favor of oil-filled and water cooled transformers is cold, hard fact.

SOME FURTHER CHANGES.

The reception accorded the last number of THE JOURNAL was extremely gratifying to the publishers. We have received many letters from friends and subscribers complimenting us on its very handsome appearance and the additional business evident in the advertising columns.

The new style title adopted is in direct line with all other first-class publications in our field, and the fact that the additional space on the front cover secured by the change was immediately taken by two very discriminating firms—The American Steel and Wire Company and the Meese & Gottfried Company—is evidence that THE JOURNAL is highly regarded as an advertising medium.

Our reason for changing the color of the cover was to more fully bring out the handsome half tones with which our advertisers embellish their printed matter, and also to give a brighter appearance to the publication.

It will be noted that we are still adding to our advertising patronage, and within a short time, owing to the

amount of new business promised, will be obliged to increase the number of reading pages of THE JOURNAL so as to have them balance the amount of advertising offered.

The subscription list is gradually increasing, and we have yet to hear of any subscriber stopping service of THE JOURNAL on account of the advance in price.

The continued demand for back numbers of THE JOURNAL to complete annual files is evidence enough of the valuation placed upon its contents by discriminating readers. We have been called upon within the last month to furnish information regarding long distance transmission to a number of Eastern commercial organizations, who have become alive to the fact that California today in many ways, leads in this branch of electrical development.

We have only space enough to cite one instance of this kind, and quote below an extract from the address of William M. Bunker, Washington representative of the Chamber of Commerce of San Francisco, delivered before the advisory board of the Philadelphia Commercial Museum, at its annual session, held October 7th, 8th and 9th, under the title "The Pacific Coast as the Fixing Factor in Our Asiatic Trade Problem." Mr. Bunker's reference to the work that has been done in California was as follows:

> The transmission of water power in California by electricity is profoundly interesting because the records of the world for long distance transmission have been boldly broken. The Edison Electric Company, No. 3, has a water head, or fall, of 1860 feet. This is a world record. Ten years ago the pioneer electrical transmission plant transmitted 10,000 volts from San Antonio Canyon to Pomona and San Bernardino, a distance of thirty miles. This was the beginning of water power transmission in California. The electric transmission plants have rapidly multiplied. The Folsom-Sacramento plant transmits 4000 horsepower twenty-two miles at 10,000 volts. The plant of the San Joaquin company, with a voltage of 19,500, transmits power sixty-nine miles. The Bay Counties Power Company delivers light and power in San Francisco and half a dozen nearby cities from San Jose to Santa Rosa over wires exceeding 125 miles in length. The Standard Electric Company delivers power and light to Stockton, San Jose and San Francisco and about twenty-five smaller towns on the route from the Sierra Nevada Mountains to San Francisco Bay over a distance of approximately 200 miles of wire.
>
> The electrical transmission in California aggregates 100,000 horsepower. There are projects now under investigation where it is proposed to develop from 10,000 to 250,000 horsepower at single sites for transmission to the largest cities within a radius of 100 miles from San Francisco. With the radius of transmission raised as it is to over 200 miles, there is more than 1,000,000 available horsepower in known sites awaiting development.

The above information was furnished by THE JOURNAL, showing the benefit to California and to all interested elsewhere of having a publication which at an hour's notice could furnish the statistics necessary for an address of this kind. It would have been impossible to have gathered the data from the companies engaged in furnishing electric power in time for Mr. Bunker's use, and this portion of California's development would have had to be slighted or an approximate value only given. We call attention to this to show the value of THE JOURNAL, not only from a technical standpoint, but also as a factor in furnishing information that is beneficial to the State and to the Pacific Coast at large.

OUR ANNUAL NUMBER.

We wish again to impress upon our readers and advertisers the fact that our January number will be the most interesting and ornate edition of THE JOURNAL which we have ever published, and while we are already in receipt of numerous applications for enlarged space from regular advertisers, and from many new advertisers who have favored us with contracts for this number, we have still a number of pages to fill. The time is growing short, and we would ask for early consideration from those desiring to come in with us in this edition. There will be no additional price charged for the January number, and those desiring extra copies will be furnished at the regular rate.

DELAY IN PUBLISHING.

We have to apologize this month for the lateness of publication, and in justice to ourselves, desire to state that the congestion in the numerous printing offices and press rooms, brought about by the vast amount of political printing for the campaign just ended, has made it impossible for them to handle our work. Now that the campaign is over, we do not see any reason, except for some serious breakdown, why our paper should not come out as promised on the regular date of publication hereafter.

THE RISE AND RECOGNITION OF THE ENGINEER.

(Continued from page 215.)

how he would have fared had not the incandescent gas light just then made its appearance to shed a ray of hope for gas and check the advance of the "electrical firefly," as it was then derisively referred to. Probably no better illustration of the gas man's contempt for his electrical competitor can be given than in this bit of verse, published in one of the gas journals of that day:

> Said Edison, "So, and won't the thing go
> Despite how on paper we rush it?
> We'll take it by storm, a company form,
> And then get behind it and push it."

And they did; and how queerly sounds the verse after twenty years.

While the fraternity received the incandescent gas light with open-arms welcome, coming as it did at a most opportune time as a saviour of a portion of the lignting business, one shudders at the thought of the chilliness of its reception, had it antedated electricity and seemingly gave to the gas manager naught but a declining revenue, while to the consumer it brought more value and comfort.

This mistake would, however, soon have become apparent, for while the incandescent gas light has been of value in retaining business, it has been of immeasurably greater benefit in teaching the importance of recognizing the interests of the consumer and the search and development of new fields of extended usefulness of gas, all of which forced a new condition of affairs to such an extent as to call for ability which knows not alone how to produce gas of good quality at low cost, but, having accomplished that desideratum, then recognizes it as of secondary importance to its disposal; for the successful engineer of today is he who wholly understands not only the manufacture but the handling and disposition of his product, save, possibly in the few cases of very large

works wherein the full attention of the engineer is occupied with gas manufacture only, this being, indeed, a more or less regrettable condition, tending as it does to the restriction and narrowing of a general knowledge which may be sadly missed should a change of employment demand a broader and more comprehensive insight into a too frequently overlooked portion of the industry.

The successful gas engineer of the period, and the one whose services are always in demand, is he who has a thorough practical knowledge of his profession, with enough theoretical ability to enable him to understand the cause and effect, as it were, of that which engages his attention. His technical theoretical knowledge cannot be too great, as long as it is made the servant of practice, but theory alone is of small usefulness save as a brain food to an inquiring mind, and for this reason is it that our most useful and helpful artisian—the chemist—does so little for himself in a material way, though showering multitudinous blessings on humanity by placing his knowledge at the disposal of practical men.

In the manufacture and use of gas the engineer must needs have a certain and comprehensive knowledge of that part of chemistry applying to his profession, though it is by no means necessary that he should be highly skilled therein, and, indeed, unless he has much time at his disposal, an almost inconceivable condition, he would better deputize that portion of his work to the skilled chemist.

Tne gas engineer must also be a physicist to a certain extent, for, aside from the chemistry involved in the manufacture and use of gas, physical laws govern its handling, and therein must the engineer be self-reliant and well nigh self-sufficient.

Physical laws, almost, if not quite, wholly govern the distribution of gas, and their knowledge, combined with the laws of chemistry, enables the engineer to ask himself that all important question, "Why?" Ability to answer pre-supposes a query, and enables the seeking of cause for oneself, and when that old fallacious saying, "the long since acknowledged fact," is thrust upon one, the ability to substantiate or disprove is given by the knowledge possessed.

Probably no other saying has caused more lack of personal observation than that same old trite "long since acknowledged fact," and whenever it is heard one should immediately become suspicious of the user and undertake personal observations.

Both mechanical and civil engineering enter into the necessities of the gas engineer, mechanics dealing with the construction of works and civil engineering to a certain limited extent in the proper placing of gas mains, etc.

The profession of gas engineering is one which is not commonly taught, and it is usually mastered by only a few who have the love of a diversified, scientific knowledge, or who acquire it by contact with their fellow workers. The latter class predominates, and gathers its knowledge by mastering one feature after another, advancing along the highway of success, or probably better said, the narrow path of success, although too often is superficial information mistaken for profound knowledge, thus continually demonstrating the old axiom, "A little learning is a dangerous thing."

No real knowledge is too elementary, and each acquisition creates a desire for more, but information is not knowledge, and, therefore, the value and necessity of self proof and demonstration, which are the true gages of knowledge and science, science being knowledge reduced to a system.

The value of investigation and research is no better demonstrated than by the work of the already referred to chemists, who in ancient times believed in the existence of but four elements—earth, air, fire and water—and ridiculous as it now seems, their conclusions were not entirely without logic, for in all of their investigations they found a recurrence of their supposed elements and every substance was supposed to contain all of these.

As a matter of instance, the heat of friction indicated the presence of latent fire; ash, the result of combustion, was believed to be earth; and the escaping gases as the result of additional combustion were looked upon as air; while the condensed products of combustion, from even previously dried substances, indicated the presence of water. The fallacy of this theory eventually became evident by gaps in the system, thus allowing for the filling in of new discoveries, which can often be foretold from gaps in any system, and without which the progress of the nineteenth century would have been impossible.

Improvements come slowly but surely, and the ability to take advantage of the opportunity is the evidence of the skilled engineer, and these opportunities are now more than ever before arising in the gas profession.

One of the most vital questions of the age is the production of a convenient, clean, safe, cheap, smokeless fuel, suitable for all uses, and surely no other known substance possesses all of these desirable features in so marked a degree as does gas. Thus is given to the engineer the task of solving one of the world's greatest economic problems, and the recognition of his valuable and appreciated services has come to stay. To what heights may it not obtain.

The production of artificial light, necessary as it is, is of declining importance when compared with fuel, in addition to which the term fuel in the gas world is now synonomous with light as it is also with power, for does not a supply of proper gaseous fuel mean the rapid development of the all too long overlooked gas engine.

Gas engineering is an honorable, respected and recognized profession of standing and importance, and calls for a degree of skill second to none. It affords remuneration exceeding that of other engineering professions, but to be successful, ability and application are requisite, and to gain this recognition gas engineers must adhere to their profession, keeping step with the drum beats of the twentieth century, and remembering that to humanity smokeless fuel is of much greater importance than smokeless powder.

IMPURITIES IN CRUDE PETROLEUM OF LOW GRAVITY.*

BY P. W. TOMPKINS.

THE recent extensive development of the oil fields of California, with a large production of oils of very low gravity, has brought about the need of some new method for the rapid determination of the crude foreign matter contained therein (sand, water, etc.). The well known character of the California oils, with from 0 to 40 per cent. of asphaltum, makes the generally accepted method throughout the East—namely, 100 cubic centimeters oil mixed with 150 cubic centimeters gasoline, heated for six hours at 120° F., and standing from two to eighteen hours—not always adapted to the oils in question.

As yet there has been no uniform method for such a determination adopted in California. In fact, the work done heretofore on the subject has been of rather crude character, and nothing has been developed of any importance. The different buyers and sellers should agree on some form of the gasoline test which would mutually satisfy the interested parties, hardly any two being alike, and naturally with such lack of uniformity dissatisfaction has arisen, as has also the hope for a more practical solution of the problem. About two years ago the subject was brought up, but owing to the lack of time it was given little or no thought till within the last eight or nine months. Experiments were first made on some oils of about 17.5° B., with 26 per cent. asphaltum and with about 4.5 per cent. sand and water, and also on some other oils of much higher gravity. The method employed for the work was that adopted by the New York Oil Exchange, with some slight variation in the proportion of gasoline. The method worked very well with oils of high gravity, but the results were in all cases a little too low with crude oils from 10° to 20° B. The principal objection to this method for its practical use in the fields here is the necessity of heat, without which the results are in no way correct. From this objection has arisen the need of a gasoline test not dependent on heat to obtain the required results.

*A paper presented to the Tenth Annual Meeting of the Pacific Coast Gas Association, San Francisco, Cal., July 15-16, 1902.

A large producer of the Kern River district, who had made a contract, extending over several years, to supply oil for refining purposes (500 to 600 barrels a day), the so-called foreign matter to be determined by a one-quarter gasoline test, brought the subject up some months ago.

The method then in use for this test (one formulated by the purchasers of the oil) was submitted by the producers for examination and scrutiny to ascertain its accuracy, etc. This method was accompanied with an average sample of their oil (16.1° B.) to be examined, which had been pumped from a number of wells to the slump holes, and from the slump holes pumped to the settling tanks for further deposition, and it was from these tanks the oil was taken for examination. Many of these heavy oils, when first pumped from the wells, carry from 15 to 35 per cent. sand and water, but in most cases the majority of it deposits if sufficient time is allowed.

FIRST METHOD SUBMITTED.

Two hundred cubic centimeters of oil is put into a stoppered glass graduate holding 1000 cubic centimeters; 750 cubic centimeters of gasoline is then added and the tube is well shaken to thoroughly mingle the oil and gasoline. The mixture is allowed to stand twenty-four hours; 900 cubic centimeters of the mixture is then drawn off with a siphon, which draws downward from a point 50 cubic centimeters from the bottom of the tube, leaving 50 cubic centimeters of the mixture, and which contains all the foreign matter there was in the 200 cubic centimeters of oil. This 50 cubic centimeters is then poured into a 100 cubic centimeter stoppered graduate; 50 cubic centimeters of gasoline is then used to wash out the 1000 cubic centimeter tube, and with the particles of foreign matter washed from the sides and bottom of the 1000 cubic centimeter tube, and added to the 50 cubic centimeters in the 100 cubic centimeter tube. This is then well shaken, and after standing twenty-four hours the reading of foreign matter at the bottom is assumed to be the percentage of foreign matter in the oil from which the sample was taken. While the 200 cubic centimeters of oil and the 800 cubic centimeters of gasoline used would make it appear a 1 to 4 mixture, it is not necessary to point out that this method does not give a one-fourth proportion at any stage in the operation. In the first mixture of 200 cubic centimeters oil and the 750 cubic centimeters gasoline the ratio of the oil to gasoline is 1 to 3.75 parts, while the last 50 cubic centimeters, with the foreign matter, and containing approximately 10.5 cubic centimeters of the original oil, and mixed with 50 cubic centimeters of gasoline, would be in a ratio of 1 to 9.

Several determinations of the foreign matter were made on the oil by the above method, which was found to be in excess of the true amount, due to the excessive use of gasoline in the last step of the operation. Asphaltene was thrown out of solution which deposited with the foreign matter, giving an erroneous result. Other determinations were made by this method, as amended, to avoid the precipitation of asphaltene. In short, this is to mix the 200 cubic centimeters of oil with 800 cubic centimeters of gasoline, allowing it to stand twenty-four hours. Siphon off 950 cubic centimeters, retaining part of it, (*i. e.*, the petroleum solution) in a wash bottle. The remaining 55 cubic centimeters containing the foreign matter is transferred to a 100 cubic centimeter graduate. The liter cylinder is then washed with a little of the petroleum mixture. This is added to the 100 cubic centimeter graduate and the whole allowed to stand for twelve hours. By this means the ratio of 1 to 4 oil and gasoline is maintained throughout, and obviates the necessity of using exactly 50 cubic centimeters in washing the liter graduate, or of adhering to any definite volume. Any amount necessary to produce the desired result can be used; 25 or 100 cubic centimeters, if it is sufficient, would not alter the result.

On all of these determinations the true amount of foreign matter contained therein was accurately determined. The average summary of the work evolved through the various experiments is as follows:

Foreign matter obtained by the method—		
As submitted	2.06 per cent.	
As amended to avoid the precipitation of asphaltene	1.61 per cent.	
Difference due to asphaltene		.45 per cent.
Actual foreign matter obtained	1.38 per cent.	
Difference due to unavoidable mechanical error		.23 per cent.
Total error		.68 per cent.

The results of the above experiments show that the source of error in this method submitted for trial lies practically in the amount of gasoline used at the end of the operation. In the case of this oil the total error is about .7 per cent. Of this approximately .45 per cent. is produced from the last 50 cubic centimeters of the gasoline used, and the remaining .25 per cent. from the trifling amount of emulsion formed in shaking, but principally due to a mechanical error, which is unavoidable, and produced by the adhesion of a filmy coating of petroleum solution to the finely divided clay and globules of water, which do not congeal into one body, but remain completely disintegrated, even after heating. From subsequent work done on another method, with practically the same ratio of oil to gasoline, it was found that twenty-four hours' standing is longer than is required to produce complete precipitation of all the foreign matter present.

Nothing more was done on the subject for a few months, when the same parties already spoken of came and presented another method, one then adopted and prepared by the purchasers of the oil for the determination of the foreign matter, the first method having been discarded. This method was also accompanied with another average sample of the producers' oil (16.8° B), taken in the same manner as was the first sample. The method submitted is given below as received.

SECOND METHOD PRESENTED.

Two hundred cubic centimeters of oil is placed in a 1000 cubic centimeter tube, and 550 cubic centimeters of gasoline of 74° B. added, well shaken, and then poured into a glass globe of 1200 cubic centimeters capacity. This globe has two necks, one to fit into the top of the 100 cubic centimeter tube, the other to be corked. The 1000 cubic centimeter tube is then washed out with 170 cubic centimeters of gasoline, and this washing also poured into the globe. This globe is then set into the top of the 100 cubic centimeter tube and the mixture allowed to stand for four hours; 900 cubic centimeters of this mixture is then siphoned off; 80 cubic centimeters of gasoline is then used to wash out the globe (still standing in the top of the 100 cubic centimeter tube) and into the 100 cubic centimeter tube. After standing one hour the reading is taken. This, like the first method, was supposed to be 1 to 4, oil and gasoline test, because of the 200 cubic centimeters of oil and 800 cubic centimeters of gasoline used in the operation. As is seen from the first amount of 200 cubic centimeters of oil, and 550 and 170 cubic centimeters of gasoline, it is in the ratio of 1 to 3.4 parts, and in the last step, with the 20 cubic centimeters of this petroleum solution, containing 4.34 cubic centimeters of the original oil, are mixed with 80 cubic centimeters of gasoline, making a ratio of one part of oil to seventeen parts of gasoline, which proportion would be even greater if the per cent. of foreign matter were taken into account.

As this method promised a greater precipitation of asphaltene in the last step, owing to the decreased amount of oil taken and the increased amount of gasoline used over that of the last method, this point was first investigated. It developed the fact that about 1.25 per cent. asphaltene was precipitated with the foreign matter, nearly doubling the correct reading.

It was further found that the one hour standing in the last step of this method was not, in the majority of cases, sufficient to produce the minimum reading, nor was the four hours' standing enough to allow a complete precipitation of the sediment in the first step. The average of the work done on this oil, as proposed in the second method submitted, gave the erroneous result of 3.12 per cent. of so-called foreign matter. The error entering into the above figure is clearly shown in the following table:

Mineral matter	.025 per cent.

Organic matter (not asphaltene)	.005 per cent.
Water	1.325 "
Average unavoidable mechanical error	.260 "
Foreign matter by method when properly conducted	1.615 "
Error due to insufficient standing	.240 "
Asphaltene	1.265 "
Incorrect percentage	3.120 "

In other words, the actual percentage composition of the true foreign matter is:

Mineral matter	1.845 per cent.
Organic matter (not asphaltene)	.369 "
Water	97.786 "
Total	100.000 "

As a result of the above investigation in the work subsequently done, the 80 cubic centimeters of gasoline was not mixed with the 20 cubic centimeters containing the sediment, but used simply as a washing fluid to remove all particles from the globe to the cylinder. By this manner of conducting the method the solutions were kept separate, except at the junction of the two liquids, which was not sufficient to produce any appreciable deposit of asphaltene.

The average results of the work done on this method (and this oil) are:

After one hour standing (excluding asphaltene)	1.91 per cent.	
After twelve hours standing (excluding asphaltene)	1 65 per cent.	
Decrease due to insufficient standing		.26 per cent
Actual foreign matter contained therein	1.40 per cent.	
Decrease due to unavoidable mechanical error in method		.25 per cent.
Total error		.51 per cent.

From examination of the above results it is plain that there are two small errors in this method, even when properly conducted.

1. The error introduced from insufficient standing would be overcome if the sample were allowed to stand twelve hours instead of one in the last part of the operation. The error is greater in some cases than in others, depending upon how vigorously the 200 cubic centimeters of oil are shaken with the 550 cubic centimeters of gasoline when mixing.

2. An error of .25 per cent., due entirely to mechanical causes, which have already been described, and which cannot be overcome by any ordinary means.

It was then thought to be desirable to compare this second method now under discussion with an oil of known amount of foreign matter, and, therefore, several determinations on the sample first received were made, with average results as follows:

After one hour's standing	1.75 per cent.	
After twelve hours' standing	1.66 "	
A decrease due to eleven hours' longer standing		.09 per cent.
Average foreign matter already determined on this oil	1.38 per cent.	
Unavoidable mechanical error		28 per cent.
Total		.37 per cent.

A glance at the several average tables makes it quite evident that the greatest source of error in the first method, namely, the precipitation of asphaltene (error .45 per cent.) is practically eliminated in the second method, if the operation is properly conducted; that is, without mixing the 20 cubic centimeters and 80 cubic centimeters in the last step, without which precaution the error would be much greater.

The foregoing work on these two methods, and the two different samples of oil from the same wells, demonstrate that the unavoidable mechanical error previously alluded to is quite constant, as will be seen below:

Method used	1st.	2d.	2d.
Oil used	1st.	1st.	2d.
Average foreign matter, including unavoidable mechanical error	1.61 per cent.	1.66 per cent.	1.65 per cent.
Average true foreign matter	1.38 per cent.	1.38 per cent.	1.40 per cent.
Unavoidable mechanical error	.23 per cent.	.28 per cent.	.25 per cent.

It has been ascertained that heat does not materially aid in diminishing this error, and is not worth considering in view of the time consumed.

It is well to mention here that the per cent. of asphaltene by volume destroying the true reading of any method cannot be ascertained alone. Owing to the floculent condition of the asphaltene (which has no constant value), it must be determined by difference. To obtain the desired figure, the per cent. of true foreign matter, etc., is deducted from the original incorrect per cent. containing the precipitated asphaltene. This is quite apparent when observing that the asphaltene precipitated alone occupies a much larger volume at first than after some standing, while the foreign matter and asphaltene determined together assume nearly the correct volume after the first hour's standing. These facts are more clearly shown by comparing the following summary derived from the work done by the second method and the second sample of oil. The asphaltene and foreign matter determined together are:

After standing—

1 hour.	4 hours.	8 hours.	18 hours.	4 days.
3.12 per ct.	3 per ct.	2.88 per ct.	2.88 per ct.	2.80 per ct.

Total difference between one hour and four days' standing equal .32 per cent.

The asphaltene determined alone is:

After standing—

	1 hour.	18 hours.	4 days.
	2.7 per cent.	1.21 per cent.	.8 per cent.
Adding the average true foreign matter, including mechanical error	1.65 per cent.	1.65 per cent.	1.65 per cent.
	4.35 per cent.	2.86 per cent.	2 45 per cent.

The total difference between one hour and four days' standing equal 1.9 per cent.

The last figures obtained from adding the asphaltene determination alone, to the correct foreign matter, to include mechanical error, only agree at the point of eighteen hours; before and after that time they are at variance.

We have found from practical experiments that eight hours' time is necessary to render the deposit of foreign matter complete for all practical purposes, while the four hours prescribed in the first step of the second method is inadequate. In the last step of this method, where the foreign matter is concentrated into a small bulk, the precipitation takes place very much more rapidly, and in a few cases the one hour allowed by the method is sufficient to give the minimum reading; but the precipitate does not in the majority of cases reach its most settled or compact state for several hours. It has been demonstrated that twelve hours is the time necessary to cover all conditions, after which period it does not change further.

Since the density of the oils vary so in California, it is not practicable to prescribe any fixed amount of gasoline to be used in these methods for all oils. It may be said that 800 cubic centimeters of 70° B. gasoline and 200 cubic centimeters of oil is about the right ratios for crude petroleums between 15° and 20° B., but below 15° B. 850 cubic centimeters of gasoline and the same

amount of oil is preferable. Between 20° and 28° B., 750 cubic centimeters of gasoline and 200 cubic centimeters of oil is all that is required to give satisfactory results, and beyond these points there is little or no call for such determination.

With the heaviest of these oils, 850 cubic centimeters 70° B. gasoline is a safe limit to use so as not to endanger the precipitation of asphaltene. From experiments on an oil of 12.5° B. it was found that with 200 cubic centimeters of oil and 900 cubic centimeters of gasoline, 70° B., the danger line was approached, and when the same amount of oil was treated with 950 cubic centimeters of gasoline a slight deposit of asphaltene took place.

CONCLUSIONS.

In conclusion, this second method, when proper precautions are taken, is nearly correct, and a great improvement over the first method in its ease of manipulation. However, the precautions necessary to obtain correct results so closely border on danger lines that they must be strictly adhered to. In order to free this method from several unsatisfactory features and make it uniform for all operators, we have, after careful study and much practical work on this subject, adopted the following: Two hundred cubic centimeters of the well averaged oil are placed in a 1000 cubic centimeter graduate and 600 cubic centimeters of 70° B. gasoline added, thoroughly mixed, and then transferred to a large (about 1200 cubic centimeters capacity, with a wide and deep neck above the stop cock) separatory funnel. The liter graduate is then washed out with 200 cubic centimeters of gasoline and washings also added to the funnel (thus making the 1 to 4 mixture), its contents well mixed by a rotary motion, and then set aside to stand eight hours. After this time has elapsed 925 to 950 cubic centimeters of this mixture is drawn off by first starting the siphon when the end of the tube is near the surface of the liquid, then lowering it gradually to the proper point marked on the separatory funnel, retaining part of the siphoned mixture in a wash bottle. The 50 to 70 cubic centimeters remaining in the funnel is mixed by a rotary motion, the stop cock opened and the liquid containing the foreign matter is allowed to flow into a 100 cubic centimeter graduate. The funnel is then thoroughly washed out with the siphoned petroleum mixture, and the washings also added to the graduate. Generally 30 to 50 cubic centimeters is ample to remove all traces of foreign matter from the funnel, making a total bulk in the graduate of about 100 to 125 cubic centimeters, though no particular volume is required. The 100 cubic centimeter graduate is then rotated rapidly between the palms of the hand to dislodge any particles adhering to the side of the graduate. This is allowed to stand twelve hours and a reading then taken. This manner of conducting the operation, which is the most simple and satisfactory way of any method yet advanced for the determination of foreign matter as applicable to the heavy oils of California, maintains a uniform proportion of oil to gasoline throughout, with no danger from the precipitation of asphaltene, and overcomes the error produced from insufficient standing.

The method just described was tested with a heavy Kern River oil (12.4° B.) before it was finally adopted. The sample stood in the laboratory for more than a year, and contained an unusual percentage of foreign matter for such long standing. The oil was drawn off from the surface to avoid taking up any sand or water that might have settled out. That which was found in sample so drawn off probably never would deposit further. The result was 11.8 per cent. of matter foreign to the oil, with a percentage composition of:

Water	5.8	per cent.
Mineral matter	4 7	"
Organic matter (not asphaltene)	.5	"
Unavoidable mechanical error	.8	"
Total	11.8	"

The mineral matter in the various oils examined was not sand in the strict sense of the word, and was in a very fine state of division. A general idea of the mineral contents of the oils can be gathered from a partial analysis made of the 4.7 per cent. mineral matter contained in the oil last referred to, which had:

Silicon (SiO_2)	52 70	per cent.
Ferric and alumina oxide (Fe_2O_3, Al_2O_3)	24.15	"
Lime (Ca O)	6.38	"
Magnesia (Mg O)	1.79	"
Sulphur trioxide ($S O_3$)	3.91	"
Undetermined (soda, potash, carbon dioxide, etc.)	11.07	"
	100.00	

In their natural state parts of these ingredients exist in the form of some insoluble silicate, while a considerable portion is readily soluble before fusion.

It must be borne in mind that the per cents of foreign matter obtained from properly conducted methods of the kinds given are not strictly accurate, but are sufficiently close for most practical purposes. The unavoidable error entering into the method last described is proportionally about .2 to 1 per cent. in excess of the true amount, in oils containing from 1.5 to 13 per cent. of foreign matter; but as the majority of the oils tested do not contain more than 5 to 7 per cent. foreign matter, and usually less, the error involved is not greater than .3 to 5 per cent. Should greater accuracy be required totally different and more laborious methods must be resorted to.

The Sixth Annual Transmission Convention.

Official Report of the Discussions Held Upon the Papers Read Before the Recent Meeting of the Pacific Coast Electric Transmission Association.

(CONTINUED.)

EVENING SESSION.

June 17, 1902.

THE PRESIDENT. You will please come to order. The first business tonight will be the reading of an essay by Professor McAdie on "Cloud Versus Coal."

MR. MCADIE. Mr. President and gentlemen: It is an interesting fact that today, 323 years ago today, a small vessel put around Point Reyes to get in out of the wind. It was the good ship Golden Hind, about one hundred tons burden, crew about one hundred and three, Francis Drake, master. That was forty years or more before the Pilgrim Fathers landed on Plymouth Rock. This little ship had done wonders. It had crossed the Atlantic, gone down the coast of Brazil, through the Straits of Magellan, up on the Pacific side, stopping at Panama to rob a Spanish settlement—for they were robbers. Then, shaping his course northward, Drake turned a new furrow in this great ocean, or, as he called it, the South Sea. All went well until he reached the latitude of about 42 degrees. There he struck our familiar northwest wind of summer, and the men complained bitterly of the cold and the fog. He was driven southward from about the Oregon line to Point Reyes, about thirty-five miles to the north of us, and he doubled the point today, June 17th, and put in to get out of the

*THE JOURNAL, Volume XII, page 118, June, 1902.

cold. The whole object of the brief paper which I am about to read tonight, is to show that we are in a similar position to that of Francis Drake and his crew with reference to the great developments that are yet to come in connection with electricity. It never occurred to Francis Drake and his crew, as they looked at the clouds, that in the birth of a cloud a wonderful physical process was at work, and that process men of his own race and kin were to master, and by its aid they drive today great ships through the ocean, or drive their trains over the mountains—with steam, the greatest servant that man has yet had. But we who are here, believe that a greater is yet to come. [Reads paper.]

(A. J. Bowie, Jr., reads paper on "A Proposed System for the Electrical Operation of Stock Wells in Large Ranges.")*

THE PRESIDENT. Are you describing something that actually exists, or a project?

MR. BOWIE. That was a project.

THE PRESIDENT. Your estimate is as to how electricity would solve that problem?

MR. BOWIE. Yes.

MR. LIGHTHIPE. Are you figuring on self-starting motors?

MR. BOWIE. Yes.

MR. LIGHTHIPE. With condensers?

MR. BOWIE. No; not with a condenser.

MR. POOLE. I am curious to know at what price Mr. Bowie would propose to displace the venerable mule. I thought that was about as cheap power as we could get.

MR. BOWIE. The mule, himself, is not worth very much. It is the cost of operating—driving him around.

THE PRESIDENT. What price did you expect to get for the current?

MR. BOWIE. The current cuts almost no figure at all, the power used was so small; it was only about fifty or sixty continuous horsepower. It was only about $500 a year or so.

THE PRESIDENT. I mean from the party who consumes.

MR. BOWIE. That was the company, itself; the company installing the plant for itself. The market for embalmed beef has made mules go up, I believe, so that they would be worth something.

MR. POOLE. As I understand it, each one of these wells is now equipped with a mule and a man and woman. Is that the idea?

MR. BOWIE. The equipment is not quite so complete as that.

MR. POOLE. You take into consideration mule feed, and the feed for the attendants. I presume that the attendant's duties did not consist wholly of attending to the mules.

MR. BOWIE. They did, entirely.

MR. POOLE. Under those conditions, I can see how, with low price for electric power, it would be quite feasible to displace the mules.

MR. BOWIE. There was one place in here where two men attended to two different pumping stations.

MR. POOLE. I thought it was for each station.

MR. BOWIE. No.

MR. LIGHTHIPE. I saw one of those mule systems in full operation at Bakersfield, and the mule was blinded, and a small boy was firing rocks at him to keep him going—to keep him from going to sleep.

MR. POOLE. It would be interesting to know what figure of deterioration was placed on that mule. [Laughter.]

MR. BOWIE. In making that estimate, I will say that no expense has been figured in for the mule except what he consumes. He has been considered as absolutely useless, and not worth anything at all, and no charge has been made for his use, only for what he eats up. Of course, it is pretty strenuous work, so he has to eat pretty heartily.

*THE JOURNAL, Volume XII, page 111, June, 1902.

(Mr. John S. Eastwood reads a paper on "The Hydraulic End of Power Transmission."*

THE PRESIDENT. This is a very great subject, and immensely important in all its bearings, and ought to be intensely interesting to us. Have any of you questions to ask, or suggestions to make?

MR. POOLE. Mr. President, there are hydraulic men here that I would like to hear from on the subject. I think for myself that Mr. Eastwood's paper is of especial interest. He has had more experience in high heads in California, or as much experience as anybody else, and his observations are certainly very valuable. I should like to hear somebody who is well informed on the lines bring out discussion on the subject.

MR. STARK. I would like to ask the advisability of the maximum velocity that can be used in an ordinary pipe line, with a thousand- or fifteen hundred-foot head, with safety; the velocity of the water in the pipe line.

MR. EASTWOOD. The pipe line of the San Joaquin company was designed for a velocity of about five feet per second, but the later installation—and among them I understand the Mill Creek No. 3 plant—was designed to have a velocity of ten feet per second.

MR. POOLE. I would like to ask Mr. Eastwood if the pitting effect so noticeable on nozzles and buckets was wholly due to these cross-currents that he speaks of—the rebounding effect of the water. I have understood that some hydraulic engineers maintain that that is principally due to particles of grit becoming lodged in small cavities of the iron, and being unable to dislodge themselves, simply encircle themselves around and form a grinding process. I am not thoroughly familiar with it, but I have understood that to be one of the theories advanced.

MR. EASTWOOD. Our experience has been that this pitting out occurs at only one point, and that is a point a very short distance from the end of the nozzle tip. It certainly cannot occur by reason of grit contained in the water, because our water is discharged in one end of the reservoir and is drawn out at the other, perfectly pure and settled. There is not any grit allowed to go down to the pipe line. The water comes out perfectly clear.

MR. STARK. In a plant using snow water, located at Lundy, in Mono County, the water is as clear and pure as any I ever saw. The occasion arose to reduce the size of the nozzle, and it was done by pouring in Babbitt around a wooden mandril in the nozzle, making a casting on the inside of the nozzle—simply bushing. This Babbitt, when it was put in, showed the grain of the wood, of the pine stick that was used for a mandril. After the end of about a month's run, though the grain of the wood was still visible, the soft Babbitt showed no cutting at all. It was where the water, it strikes me, was very pure, and I failed to see any cutting.

THE PRESIDENT. I am going to suggest that this matter be resumed tomorrow morning. Our last session will be tomorrow morning at 10 o'clock, and I don't think the papers that we have will occupy the whole morning. We will get an opportunity to cross-question Mr. Eastwood, and I hope he will prepare for it. Come here tomorrow to interest yourselves with this most important theme, and get as many facts as you can from one who has had such thorough experience with the problem in its very worst aspect.

Adjourned.

SECOND DAY.

June 18, 1902.

THE PRESIDENT. Please come to order. We will devote a few moments to discussing the last paper of last night. If there are any questions to ask, or any suggestions to make, it would be a good time for us to devote ourselves to this matter. I presume that you have been musing over this all night, and that you have some ideas on the subject. Will you remark at all upon the aspects of long transmission? If not, we will proceed with the rest of our papers.

*THE JOURNAL, Volume XII, page 113, June, 1902.

MR. EASTWOOD. I would like to ask some of these people to take up this matter of the equalization of the different charges against a plant. It is one of the most vital things in engineering construction. I could touch only a little on it in my paper. The matter of depreciation, cost of maintenance, labor, charge for taking care of property after it is in operation, and the investment charge, I would like to have touched upon by some person.

THE PRESIDENT. Is there any response to this suggestion? Our time is very valuable this morning. We want to be very prompt in what we want to do. It is our last session, and we have three papers.

MR. POOLE. I think Mr. Eastwood's ideas are all right, if you can convince the capitalist that they are so. The fact of putting in high-priced construction, and running the first cost up, will discourage the capitalist from putting money into this scheme, while if a more favorable showing is made the capitalist will be induced to go into it, and take his chances on coming out whole on the proposition afterwards. In other words, I believe if the proposition were put on the lines that Mr. Eastwood suggests, in the first place, there would be a great many enterprises lost for the want of capital to start them.

THE PRESIDENT. If there is nothing further to say on this subject we will listen to a paper by Professor F. G. Baum, of Stanford, on "Surges in Transmission Circuits."*

MR. BAUM. A paper was presented about a year ago on this subject at the annual meeting of the American Institute of Electrical Engineers, at Buffalo, which attracted considerable attention, but as you all know, the paper was very mathematical and probably did not receive the attention it deserved. The subject is discussed a little more simply by Dr. Kennelly and by Mr. P. H. Thomas, of the Westinghouse Company. The subject to us is a very interesting one, because we have all seen, I think, lightning arresters short circuited, and surges by a sudden opening of the short circuit on the line. We all know that we cannot open a dynamo field suddenly. We all know that it is impossible. The amount of energy stored in the dynamo is not very great, but it is enough to destroy the dynamo. (Reads paper.)

MR. BOWIE. Mr. Baum said that the energy is proportional to the square of the voltage, as, of course, it is in the condenser. It seems to me that the rise he gets would depend entirely on the position of the current wave. That is to say, supposing that the current was maximum, and the current was in phase with the motive force; then the energy stored up is proportional to the square of voltage. You cannot add these two voltages together, because if you do, supposing they are equal, you would get four times the energy originally stored in the condenser from the line. You have a certain amount of energy stored in the condenser, and an equal amount which would be stored there from the line current, and it seems to me that the potential would not rise as high as that.

MR. BAUM. I have assumed, of course, that we interrupt the current when it has its maximum value. We have to do that in order to get our maximum strain. Mr. Lighthipe said a year ago that you can open a switch twelve times, and it will open all right, and the thirteenth time it will go wrong. We want to skip the thirteenth time. But we want to take account of the maximum possible rise. We have a current here, I, flowing over the line, and we know the energy corresponding to that, one-half of $L I^2$, and I have assumed that that energy passes into the condenser, and the energy which passes into the condenser is expressed as an equal to one-half times the capacity, multiplied by E^2. That will be the potential. From that you can calculate the potential across the condenser. But that is a high frequency current. Here is that high potential wave. Before that wave will have gone very far, this wave will come in and add to it. The generator wave will go on and add directly to the potential across your condenser. All the results agree with the results made by Steinmetz and by Townley.

*THE JOURNAL, Volume XII, page 108, June, 1902.

MR. BOWIE. I don't know that Mr. Baum saw just the point I meant to raise. It was that the energy is proportional to the square of the voltage. Supposing that the energy of the condenser, when discharged into the line—if the line had no voltage, supposing that the current was flowing, with no voltage to charge it, that would produce a certain voltage in the line itself. Now, we will suppose that the same voltage, or equal voltage, is impressed on the line by the generator at its maximum position. Then, providing these two voltages are added, the total amount of energy stored in the condenser at that instant will be four times the energy which would naturally charge the condenser. In other words, the charge from your line current flowing back will add three times its natural work to the condenser, and I should think it would not produce in that way as high a value.

MR. BAUM. I agree with that. If you double the potential across your condenser, the resulting energy will be four times; but the potential is what we are discussing. If we make the energy four times, the potential rise across the condenser will be twice. There are many cases where the rise in potential might be quite a little greater than twice. Steinmetz shows a case where you might have a rise as high as 280,000 volts. I doubt very much if you can get that on a transmission line, but you might probably produce it in a laboratory experiment.

MR. LIGHTHIPE. I would like to ask Mr. Baum how close the formula of 400, divided by the 100-mile, is?

MR. BAUM. I think it is close enough for all our engineering work. I think it is within 10 per cent., anyway.

MR. POOLE. I would like to ask Mr. Baum if the maximum voltage occurs at the instant of opening the switch, and if that is due to the increased frequency caused by the interruption of the arc, or whether it is due to the cumulative effect of the surging on the line—opening the load on the line?

MR. BAUM. Just opening the switch at the generator end?

MR. POOLE. Yes, or anywhere on the line.

MR. BAUM. You mean to open the switch down here?

MR. POOLE. For illustration, assume that you have a load of 100 amperes on the line, and you open it at the end of the line.

MR. BAUM. At this end of the line?

MR. POOLE. Yes.

MR. BAUM. If you open it at the maximum point, you get in this circuit here, an oscillating potential, independent of the generator. The potential wave would oscillate at the natural periodicity of the circuit. If the natural periodicity of the circuit is 400 or 500, you can see that at some point the generator wave is going to add to that, and at some other point the generator wave is going to take from it.

MR. POOLE. What causes the increased frequency?

MR. BAUM. The frequency is due to the natural periodicity of this circuit. We have a condition exactly like this. (Makes diagram.) Suppose we send a current through this coil; suppose we connect the generator here and remove that current suddenly. The current will continue in this circuit, but it will change to alternating current. This was a direct current before, and it will change to an alternating current, and the frequency will be determined by the natural periodicity of this circuit.

MR. POOLE. But it increases from 200 to 400 times, does it?

MR. BAUM. This might be a direct current—frequently of zero. It passes to alternating current, and the frequency is entirely determined by the value of this capacity, and the value of that induction—not at all upon the generator. If I were to put a meter here that would measure that current, I would find an alternating current in that circuit, after I interrupted this.

MR. POOLE. The resistance in the line would be a function in determining?

MR. BAUM. It is a function in determining how rapidly that current will die out. It passes from this to that. It corresponds to the resistance of your swing.

THE PRESIDENT. How long a time does this last?

MR. BAUM. It will probably last—it will work at sixty cycles in a mile, about 100 miles long. It will probably not be very appreciable after one complete cycle of the generator wave. It does last for two or three cycles of your generator. I have assumed the ordinary distance that we have in our transmission line.

MR. BOWIE. Mr. Baum says the energy interrupted is very small, the energy of induction. In fact, you can take about a five-kilowatt, 100-volt motor, and if you open the field of that you would have as much energy stored in its field as you would have in 200 miles of transmission line at 200 amperes. Of course, it would be no trouble at all to open the field without resistance across it, and, as a rule, you would not get any dangerous results, you would not be liable to break down your insulation. It is not regarded as commonly good practice. It seems to me it naturally discharges across through the spark. Of course, Mr. Baum has taken account of that. I should think these two dangers that he speaks of would be very much greater theoretically than they would be in actual practice.

MR. BAUM. The question might be brought up whether we really want switches that open suddenly or switches that open with an arc. Some advocate that we ought to have a switch that opens through a resistance, and finally cut your line dead when the current is reduced.

MR. POOLE. We have with us Mr. William Blanck, formerly engineer of Ganz & Co., Budapest, and now of the Chicago Edison Company, of Chicago, who is very familiar with these problems, and if he will, I would like very much to hear some remarks from him on the subject.

MR. WILLIAM BLANCK. I made a test in Chicago on underground cables six miles long, and found that a quick interruption of an oil switch never causes such a rise in potential as would be caused by slow interruption. A slow interruption has always shown, on an astatic voltmeter, a rise of potential of more than 40 per cent. I could not notice that with a quick interruption.

MR. BAUM. That may be true as far as the recording of the voltage is concerned, but these voltages I am speaking of no recording voltmeter will take account of, they happen so suddenly.

THE PRESIDENT. Mr. Theberath has had a great deal of experience and observation on these lines. I wish we could hear from him on the subject.

MR. THEO. E. THEBERATH. Mr. President, I have not read this paper yet, but I would like to ask Mr. Baum a question in regard to the changes which take place in a long line. For instance, we will build a line 100 miles in length. At the end of that 100 miles we will have a set of transformers connected across the line. That will give us a certain natural periodicity. After a while we get other customers in between the power house and the end of the line, and we connect a number of transformers across the line at different points—in other words, adding self-induction in multiple across the line. Would we have to consider each one of those sections from the power house, we will say, to the first transformer, and from the first transformer to the second transformer, as individual circuits, in order to determine the natural periodicity?

MR. BAUM. We would have to if we wanted to get it out accurately. As a matter of fact, I have neglected the step-up transformer here in the line altogether, because the self-induction in that transformer is small compared with the self-induction of the line. In this transformer the generator is working here, and on the other side you have a short circuit, so that the self-induction means merely the reacting pressure of the transformer on the short circuit. It will reduce the frequency some few per cent. by considering the transformer at the end of the line.

THE PRESIDENT. Are there any further remarks? If not we will listen to a paper by Mr. Medina on "Electricity and the Law."*

*THE JOURNAL, Volume XII, page 120, June, 1902.

The secretary reads Mr. Medina's paper.

(There was no discussion on this paper.)

Mr. C. W. Hutton reads a paper on "Calculation of a 50,000 Horsepower, 80,000-Volt, 200-Mile Transmission Line."†

THE PRESIDENT. We would be glad to have the matter discussed. Gentlemen, we are waiting for your ingenious suggestions on this matter. I see that Mr. Stark has an interesting "wrinkle" ready for us here. I wish he would take up our time. We have a few minutes now—about half an hour before we adjourn.

MR. STARK. The California Central Gas and Electric Company has a line from Napa to Petaluma, and, branching at Petaluma, thence to Santa Rosa and San Rafael, the substation being at Petaluma. It was considered advisable in putting in the line to put in fuses at the points on the intersection—the connection of the busbars, at Petaluma—on the Santa Rosa line and on the San Rafael line. Oil fuses were installed, and after they were installed the question arose as to how we would tell if a fuse was blown, that is, their being no ready means of detecting the voltage on this line or that line, and a piece of apparatus as a transformer for reducing the potential at ordinary means down to the reach of an ordinary voltmeter was out of the question for that purpose. I suggested the use at that time, and installed a set of Geisler tubes, of which this is a sample—a common article on the market. I suspended one of these Geisler tubes upon a single line of the circuit by a simple brass hook, and from the lower terminal of that I suspended about two square feet of condenser, such us a sheet of aluminum, in that manner (indicating). The capacity of that condenser was sufficient to make the tube glow prettily at night time. The exact area of the condenser was a matter of very short experiment. That is I took a piece of tinfoil and laid it out, and folded it until it gave the right amount of surface. The Geisler tubes had a beautiful property of lasting about a month and then quit. They are not very expensive, however. A Geisler tube in the market can be bought for about 75 cents. The question of repairs, renewals and depreciation, that the doctor has spoken of, came up. So a cheaper article was looked for. On one installation, 75 cents on a long line, is, of course, very expensive. So we took an old burned out lamp, which is a drug on the market in almost all of our stations, and coated one-half with tinfoil, and suspended the other terminal, which has the broken off carbon in it, to the line wire, and attached the sheet of condenser on the bottom, and there we have an indicator that is cheap and fills the bill.

THE PRESIDENT. How long does it last?

MR. STARK. They have the same property of dying out that the other fellows have. In continuous service the set of four that I had at Petaluma, one is glowing yet. The other three are out.

THE PRESIDENT. What do you consider would be the cause of its dying out?

MR. STARK. The cause of the dying out is the reflection of the gas. You take the same Geisler tubes that we had on the service, and if you increase the area of the tinfoil, you get the glow again. You take that coil and put it on an induction motor, and test it again, and you will see its vacuum is higher than it was in the first place. The color of the tube, itself, changes gradually from day to day. It starts with the familiar color of the blue and turns to the canary color, which approaches the vacuum of the X-ray tube apparatus.

THE PRESIDENT. How do you explain the reflection?

MR. STARK. The usual explanation of the increase of vacuum in the tube is the absorption of the gas in the side of the glass, itself, and in the oxidation or absorption in the metal of the terminal; that is, the gas actually disappears. There is not very much gas in the tube to begin with, and the disappearance or absorption of it is the cause. It is absorbed by the surface, or on the coating of the terminal.

†THE JOURNAL, Volume XII, page 134, July, 1902.

THE PRESIDENT. By what apparatus do you make it safe to hang that on the line?

MR. STARR. When the line is dead is the easiest way to hang it on.

THE PRESIDENT. You do it when the line is of no use, then?

MR. STARK. As a matter of fact, in the first experiment with the thing, I used a pole about twenty feet long, and stood on an insulator stool, and put them over the line, and they worked very prettily, and stayed there until I wanted to take them down. I simply made a hook. This is one of the original hooks. It is not a very pretty hook, but it stayed on the line after it got up there. Hanging my first hook there, and putting this over the line, it stayed.

THE PRESIDENT. It was not your object to find out whether the line was alive or dead?

MR. STARK. It stayed there all the time, and it glowed day and night for twenty-four hours. Of course, the apparatus could be put up with a switch and could last a long time if you only used it during such times as you wanted to look at it. But it was in operation all the time.

MR. MCADIE. Did you have any blown fuses?

MR. STARK. Yes, we used it twice since it was up. But there are other means, also, of telling whether a fuse is blown. The telephone service, for instance, goes out of business. Our telephone line is in almost all cases of transmission our best indicator when something has gone wrong. It throws the system out of balance. The bells ring, but, of course, the operator does not know which line is out. He cannot tell whether the Santa Rosa fuse is blown or the San Rafael fuse is blown, or whether it is something in some other part of the system, because all the telephones are connected in one multiple circuit. By going out and looking at his glowers he can tell exactly which line is out, and he can remedy it without asking anybody. Of course, it is impossible to ask anybody on the line when you can't talk. The thing is so hot you can't get near it. There is a modification of the same thing for use in daylight. I take a piece of aluminum foil and cut it into two strips about six inches long, with a center piece heavier, and attach that on the line. That represents the line (making diagram). I made a copper hook, and suspended two sheets, so, with a center piece, that way. At a line voltage of 40,000 the aluminums occupied almost a right angle to each other, that is, forty-five degrees from the horizontal, and they are easily seen, and it is a voltmeter to all intents. It is not the old electroscope we are all familiar with at school, but it is a ready made voltmeter for a high potential line, and it will indicate, and it has not the property of deteriorating, and the cost of its first installation is very small, and the depreciation, as I have found, is zero—an ideal condition. Two thousand volts will make a Geisler tube glow. Some ten or twelve years ago I used a Geisler tube on a 2000-volt circuit for determining the existence of a ground on the line. It was a double Geisler tube of the condenser pattern, and when it glowed we knew there was a ground on either leg. A Geisler tube will operate under 2000 volts.

MR. HUTTON. You couldn't make a Geissler tube operate on 2000 volts under the condition under which you are using it there, hanging on the wire?

MR. STARK. No; not by connecting it across the line.

MR. POOLE. I would like to ask if the contrivance, ingenious and original as it is, is not a subterfuge, or, rather, an excuse for better fuse? If there was an automatic indicating fuse, in itself, in the way of solenoid, of some kind, in the circuit, with an indicator on it, it would be very much simpler than the scheme you suggest.

MR. LIGHTHIPE. Under the head of "Wrinkles," I would like to suggest a scheme which they are using in the East, and especially on rotaries for indicating synchronism, and it is one which could be very easily applied to all our generator stations. It consists in painting the end of the shaft white, with black spokes, and then if you are illuminating the power house with an arc lamp, the spokes, as the new generators come up to synchronisim, will become visible. As the speed comes up you begin to see the spokes revolve, and when you are in synchronism the spokes stand still. When you go fast the spokes go the other way. It is a very ready method of finding out whether your generator is running faster or slower. It is a very simple thing, and you can put it up in a few moments.

MR. POOLE. There is one subject that I neglected to raise in the discussion of Mr. Baum's paper. I think it is a very interesting one, and if we can spare a few moments I suggest that we resurrect the subject. That is in relation to grounding the neutral of a high tension three-phase line. I would like to ask Mr. Baum's views on the subject. It is the general practice out here for us to do that. I understand he takes exception to it, and I would like to know why, what is the ground?

MR. BAUM. I take exception to it, because I know the trouble we have by doing it. You ground the neutral. I believe in grounding a neutral on a low potential circuit, a couple of hundred volts or so, in order to prevent accidents; but when you are operating a long distance transmission line the conditions are different. You are operating here a long line that is patrolled every day, and it is extremely essential that you keep all your synchronous motors running. You don't want a short circuit for even one-tenth of a second, because that will mean throwing all your syncronous motors out of speed, and make your man start up the motors from the other side. It means a delay of ten minutes. You want to avoid that. A single ground with the neutral grounded will throw your synchronous motors out of speed. If you have the neutral ungrounded it will take two grounds, I think, to do that. Furthermore, if the neutral were ungrounded, I think there would not be so much burning out of pins, and the number of accidents that you have—killing of men—would be avoided. In the case Mr. Poole cited yesterday, where the men were reeling up a wire, and the wire struck a transmission line, I think there would not have been much trouble if the neutral had been ungrounded. That man who was killed in Oakland a year ago, I think, perhaps, would not have been killed if the neutral had been ungrounded. I have nothing on the other side to offer; but it appears that it would be a better system. I have heard the argument advanced that if you don't ground the neutral on the system, the zero point of your system will chase all over, and you won't have any system at all. That, I think, doesn't amount to anything. I would like to hear from some one who has tried to operate without a grounded neutral, and see if there is any trouble. I don't see where there would be any trouble.

MR. STARK. Mr. Hancock is here, and he can tell us of a little error that was made at the towers, in which the grounded neutral came in, and there was very good service. I refer, Mr. Hancock, to the time of changing over the connection at the towers to the spare cable, and one line to Oakland was left out of the circuit entirely all the morning, and the motors at Oakland continued to run.

MR. L. M. HANCOCK. At the time referred to we were switching from one cable to another, switching the spare cable into service, and one of the cables out of service. By mistake at one of the towers they threw in the wrong switch, so that instead of having three cables in the circuit we had only two. The motors at Oakland ran right along as though nothing had happened. However, we had quite a number of synchronous motors in circuit, some of them driving generators that were feeding storage batteries. It is difficult to tell whether it were the storage batteries that held the synchronous motors into circuit, or whether it was the energy coming from the power house to the two cables. Mr. Baum and I arranged at one time to try a circuit without a grounded neutral, 40,000 volts, three-phase, star connected; but we got tangled up in some way in the work, and one thing and another, so that we didn't do it. Mr. Hutton, I think, had some-

thing to do with the change of the plant, and Mr. Lighthipe gave us some information in regard to it. I think he had considerable experience of that kind on the southern California plant. Did you not?

MR. LIGHTHIPE. We grounded the neutral in southern California, and I have never been able to ascertain whether it is any good or not. I think the grounds are still there.

MR. STARK. Mr. President, at San Rafael, the ground wire was accidentally broken at one time, and one fuse was out. In case of the distribution there we were transmitting star and distributing star. When one of the fuses was out the other two were distributing together up to about 86 per cent. of the normal voltage. If the ground had been perfect, and in good shape, they would have had the proper voltage. In other words, a disturbance of one transformer would not have disturbed the set. In other words, without grounding the neutral, where you are distributing three-phase star and receiving three-phase star, the system is more suitable on your receiving end if it is grounded than if it is not grounded.

MR. POOLE. Mr. President, Mr. Baum mentioned to my mind one of the most important points in connection with the grounded neutral. I would like to ask if it is not a fact that the zero point does shift on an unbalanced, three-phase, ungrounded circuit. If the phases are unbalanced, what is it that takes up and equalizes the system without a ground?

MR. BAUM. There is no doubt that the zero does shift on your Y-connection, if there is no ground; but the shifting is very slight, because your balancing is very slight. I think that question don't amount to anything. The main argument, I think, against taking away your ground is, that should anything happen you have got a square of three times the voltage to contend with. In other words, the man will be killed with three times as much voltage as as he would otherwise. As far as I am concerned, I would just as soon be killed with 30,000 as with the square of three times 30,000. The same argument holds with regard to transformers. You might get double voltage across one transformer, and in the paper that I have here we have arranged so that double voltage will not affect our transformers and our circuit, anyway, so that I don't think that argument holds.

THE PRESIDENT. Mr. Eastwood has some "wrinkles" in the shape of some nozzles here that he wants to show us. Perhaps he can say a word about them in illustration of a portion of his excellent essay of last night.

MR. EASTWOOD. In my paper last night I spoke about the action of water under extremely high velocities, and its conduct and action on the metal of the nozzle. I wish to disabuse the mind of any person who may think otherwise, by saying that the action that took place here took place with clear water. Our water enters the reservoir, or settling basin, at least 800 feet from where it is drawn off, and passes all this way through a channel or body of water that is over twelve feet in depth, in some places twenty-five feet in depth, so that it is absolutely a settling basin, and it takes the grit all out of the water. If there is any foreign substance, it is the very finest of clay in suspension. But at the time these marks were made the water was absolutely clear. It shows the pitting out right near the end of the nozzle, where the deflected water from the gradual tapering of the nozzle deflects the water across and strikes the opposite side, and eats out the cast-iron. Here are two nozzles, one used on the generator unit of an inch and three quarters, about, that gives us 500 horsepower, and the other is a smaller nozzle that is used on the exciter wheel. I will pass them around.

MR. BOWIE. In regard to the action of clear water on iron I want to say that in centrifugal pumps, after they have been in action a very short time, if the runners are turned up, they look as if they had never been turned—just rough castings. The water is almost pure.

LIEUTENANT W. STUART SMITH. This may be due to another fact altogether. On the backs of propeller blades swinging through the water at high speed you would not suppose there was any possibility of oxidation. Nevertheless, very severe pitting will occur, so much so that it almost pits through the face. The vessels run long distances without reversing. With a deflection there of the stream lines, small eddies will create a partial vacuum, and air will hold on that surface, and oxidation will take place there in exactly the same way as the pitting on the back of the propeller blades, and those pits seem to be the result of oxidation rather than cutting. I think it is an air effect, due to air bubbles.

THE PRESIDENT. This gentleman thinks the effect is due to oxidation, and in proof of it refers to similar phenomena on the blades of propellers.

MR. SMITH. Precisely the same thing occurs on the backs of propeller blades, where you can see the air bubbles. If you watch the propellers that are running, the air drawn in will make regular spirals, and very large bubbles hold on the back of the blades, and that oxidation is very severe at times.

MR. HUTTON. I think that explanation needs to stand in our case. We use, in our Folsom plant, turbine wheels, and I guess that there is only one other transmission plant in California where they are used, and we have trouble on the back of the blade on turbine wheels, right at the point. Where they lap one another directly opposite the tip of one blade, underneath on the other, it is pitted clear through.

MR. SMITH. I think it is purely an oxidation effect. If you can protect the surface of the material from the action of the oxygen of the air, you will not find any pitting. You could protect it by a coating. On the backs of propeller blades driven through the water there is sufficient vacuum on the back of the blades to make the air bubbles cling. There is not sweep enough of the water to wash them off. The same thing occurs here at those points where the stream lines are deflected in such a way as to make a slight eddy. Merely pure water would not stop that.

MR. HUTTON. You think the bubbles are caused by a vacuum. It must be that, because in a turbine you have a closed conduit all the way from your forebay to your tail-race, so how can the bubbles get in?

THE PRESIDENT. There is plenty of air in the water.

MR. SMITH. The working blades of the propeller never pit, but the backs pit.

MR. HUTTON. How does the air get in?

MR. SMITH. It is separated from the water.

MR. LOW. The presence of the vacuum will cause air to be pulled out from the water.

MR. SMITH. The air separates from the water.

MR. W. A. DOBLE. There is a case in the same plant where these nozzles came from where inch and a half chilled cast-iron is perforated by the direct impingement of clear water. That is not a case of oxidation. But in all cast-iron, it is a compound, you might term it, of free graphite mechanically held in iron with other chemical impurities or compounds. The free graphite is worked out by the impact of the particles of water, leaving the iron in a honeycombed unsupported condition, and the continual impact of these particles of water breaks down that iron structure, and keeps removing more free graphite and breaking it down more and more. We have it like this where velocities are accelerated very rapidly, or irregularly, and also in the turbine they find that same honeycombing which turbine people have had trouble in explaining. Right in the center of the vein, as the vein of the turbine dashes past the guides, the direction of flow of that water is changed, and sets up a reaction eddy. Of course, the water containing even a small amount of grit, in flowing smoothly, will wear a surface smoothly; but even with a very fine grit, when the water gets swirling, as it does, with the vein rushing past the guide, it sets up a swirling motion that has a grinding effect. As Mr. Stark called attention to yesterday, his Babbitted nozzles lasted longer than cast-iron. This is shown very clearly in our

results with the sand blast. You can take the glass and hold it in your hands and cut a design with the sand blast, and the sand blast has no effect upon the hand, and if it catches your nail it will tear the nail off instantly. It is because those softer metals are not affected by a sand blast, and a sand blast with water and a sand blast with air is a similar proposition. It is the actual impact of the individual particles of water which, I think, is responsible for the greatest amount of erosion that we have in our turbines, and in our high velocities, such as we deal with in high head plants.

MR. SMITH. You say that very highly chilled iron is graphite. It is very well known that in chilled iron there is very little free graphite. It is a chemical combination with the iron. It is quite a different thing from cast iron.

MR. DOBLE. In chilled iron the major portion of the graphite is combined.

MR. SMITH. There is very little free graphite in chilled iron.

MR. DOBLE. There is free graphite in chilled iron.

MR. SMITH. Nothing comparable with soft iron.

MR. DOBLE. In this particular case, the case of direct impact, it was not a case of oxidation, and we found a number of cases where the nozzle showed the same effect, and showed a most peculiar effect. Taking the Nevada City plant and the Allison Ranch Mine plant, in both cases they have, I think, four-inch nozzles, and they are both made off the same pattern. We have a nozzle of each one. In one the lines of erosion are longitudinal and in the other they are circumferential, and the erosion is worn out just as smooth as though it was cut with a milling cutter. Still, they are just in opposite directions to each other. For some time we could not tell why it was that these erosions were partially spiral, in one case, and in the other they were bands, around and around. We found out afterwards that the circumferential erosions were the primary erosions and the disturbances that they set up caused the longitudinal erosions. That is purely a case of erosion, and not of oxidation. Another thing, we have the erosion taking place in little fine lines, and the edges just as sharp as a knife, whereas oxidation would not show that effect. Oxidation would affect the surface more generally.

MR. SMITH. Not necessarily. Oxidation would attack the softer parts, not the softer places; but the place where the iron more directly comes in contact with the oxygen. If the iron is cut in such a way that some parts come in contact with the oxygen, those parts would be eaten out more quickly.

MR. DOBLE. But the effect is just the opposite. It is that part of the iron which shows the most open structure that is worn out the most rapidly, and that is where the impact has its greatest effect. The oxygen has its effect on the iron itself. The effect I speak of is seen in the plant of the Roaring Fork Electric Power Company, of Colorado. There the erosions are long channels longitudinal with the nozzle itself.

THE PRESIDENT. I am sorry to interrupt this discussion, but the time has come when we will have to bring the session to a close. It has been exceedingly interesting.

[Adjourned.]

A BIT OF ELECTRIC RAILWAY HISTORY.

BY L. B. PEMBERTON.

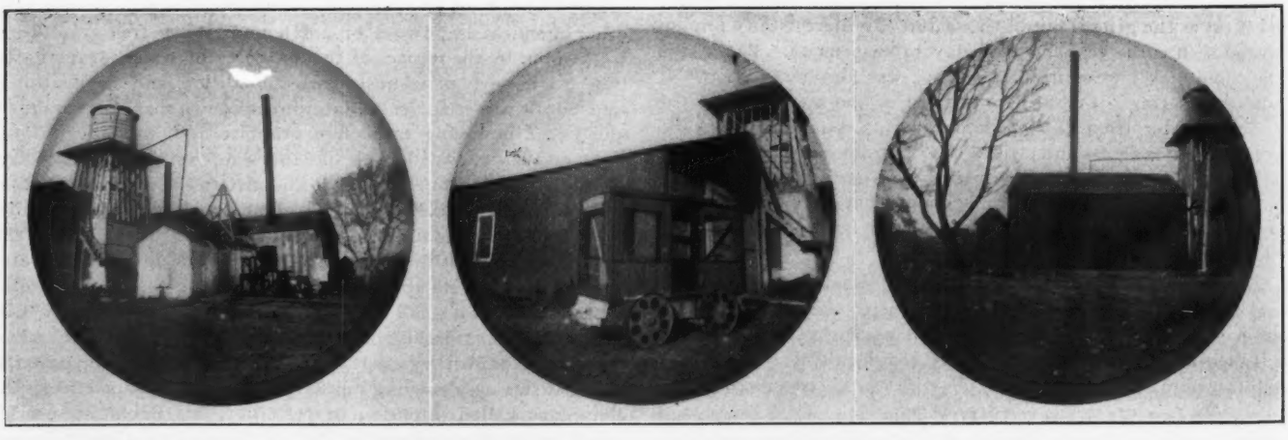
WHILE Mr. Leo Daft, whom all the electric railway engineering world knows at least by reputation, is the party to whom the credit should be given for the execution of the very interesting bit of electric railway pioneering which I am about to briefly describe, the further fact may be referred to with equal pride by my progeny a hundred years hence that to the writer of this little reminescence belonged the credit of dismantling and junking this self-same bit of electric railway pioneering away back in June, 1890.

This goes back for a period of twelve years, and it certainly seems a long time from then to now. Many new types of railway have materialized and dematerialized since the light-hearted citizens of Los Angeles gave me the "ha! ha!" for attempting to run electric cars away out to the suburbs of the city, "when the country hadn't been charged yet," and at the same time making never-to be-recorded comments on the stupidity of some folks for thinking they could push those great big cars along "with that little bit of a pole."

The equipment consisted of two locomotives and five or six short open cars. I think four of these open cars were equipped with one motor per car, the others being simply trailers. The motors were hinged at one end and placed up in the car about the middle of it, and belted down through the car floor to a grooved wheel on the car axle. A round leather belt was used, the tension being adjusted by raising or lowering one end of motor frame. The motors were compound wound, of eight or nine horsepower capacity and weighed about 1200 pounds each. The armatures were of the Gramme-Ring type, with cores made of iron wire, and held between brass ends by longitudinal bolts. The weight of the armatures was about 200 pounds. The controller consisted of a flat iron box, about eight inches square, containing a vertical switch handle operating over three notches in one direction to go ahead and in the opposite direction for reverse.

The locomotive equipment was very similar, the motors being placed on the car floor and belted to the axle. They weighed complete about two tons each, and were wired with No. 4 B. & S. Underwriter's wire, concealed in grooved wood mouldings.

The trolley was a four-wheeled affair, which was supposed to run on top of the trolley wires. It did as planned, sometimes,



A CONTRIBUTION TO THE EARLY HISTORY OF THE ELECTRIC RAILWAY.

that is when it was not crashing down through the roof of the car. The pole line construction, especially on curves was also very unique. It resembled a series of hangman's gallows.

The power house machinery consisted of two consequent pole generators of the Weston or United States type, and each of about twenty-five or thirty kilowatts in capacity. They were compound wound machines, with Gramme-Ring armatures that were wound with flat copper strips.

INDUSTRIAL.

ELECTRICITY SUPPLANTING OIL METHODS.

The Sherwin-Williams Paint Company, of Cleveland, Ohio, are equipping all their works for electric power distribution. They recently purchased for their Cleveland works three alternating-current generators of 150-kilowatt, 120-kilowatt and 75-kilowatt capacity, respectively, and about 500 horsepower in induction motors, which will be used to drive all their paint and varnish making machinery. They have also equipped their Newark, N. J., works with one 75-kilowatt alternating current engine-type generator and a number of motors and are about to install a duplicate plant at the same works. At Pullman, Ill., they are putting in a 120-kilowatt alternating current generator and one of 100-kilowatt, and about 200 horsepower in induction motors. The electrical apparatus for the several plants is being furnished by the Westinghouse Electric and Manufacturing. Company.

RAPID TRANSIT: FIVE MILES A MINUTE.

THE assertion at the present time that people will soon travel at the rate of five miles a minute may seem somewhat exaggerated, but certainly not as much so as it would have been a few years ago to state that they would be able to converse over a distance of five hundred miles, which has now become an everyday occurence.

A new system of rapid transit is proposed which embodies as one of its main features the reduction of atmospheric friction by making the surface of the car, through simple mechanical means, movable under the action of the air thus substituting solid for gaseous friction. This is another application of the antifriction device of Mr. F. L. Buford mentioned in the article in the last issue of the Journal on the reduction of skin friction on the hulls of steamships, the laws of friction of the air being the same as those of water.

The Illinois Car and Equipment Company, of Hegewisch, Ill., just outside of Chicago, has recently purchased a large amount of electrical apparatus which will be used for the operation of wood-turning machinery. An order on the Westinghouse Electric and Manufacturing Company includes two 250-kilowatt and one 200-kilowatt two-phase alternaters, together with a four-panel switchboard and the following induction motors: Two 100 horsepower, five 75 horsepower, and one 50 horsepower.

The above cut is a reproduction of a photograph of the largest switch board ever manufactured on the Pacific Coast. It was made for the Wagner-Bullock Electric Company of California by the Century Electric Company. This board is to be used in the "Alexander Young" Building, Honolulu, H. I., and consists of three generator, and two feeder panels of Vermont blue marble 3 feet by 4½ feet, by 1½ inches thick, mounted on 2 by 2¼ angle iron, and set on ornamental cast iron legs 18 inches above the floor. The dimensions of the whole switchboard is 8 by 15 feet over all.

This switch board was accepted by the Wagner-Bullock Company of California in company with a number of electrical experts, and all declared it to be the finest board they had ever seen.

The "Alexander Young" Building at Honolulu is considered to be the most magnificent structure in the Hawaiian Islands, and it is a matter of congratulation that San Francisco firms secured the electric installation.

The Joshua Hendy Company had the contract for the wiring, the Union Iron Works supplied the Engines, and the Wagner-Bullock Company the generator, switchboard, and ten horsepower motor.

LACEY MAXIMUM CURRENT CONTROLLER.

MANAGERS of central stations have always found one great objection to supplying current at flat rates, namely, that this business could not be handled at a profit on account of their inability to keep down the consumption when meters were not employed to register the amount of current used. Then, too, there are many cases where the amount of current required is so small that it would not pay to install and maintain a meter.

The Lacey Maximum Controller has been designed with a view to overcoming these difficulties and enabling lighting companies to make a profit upon business that has been handled at a loss, or that has not been handled at all.

It takes the place of a recording meter, and is connected in circuit with the lamps in a similar manner. It can be adjusted for any amount of current up to five amperes, and can be used upon either direct or alternating currents. If the smallest amount of current in excess of the adjustment is allowed to pass through the coil the circuit is automatically opened and closed, causing the lamps to flicker to such an extent that they are rendered useless for lighting purposes until the current is reduced. For instance, the controller may be adjusted for five sixteen candle power lamps. Any number can be used up to this amount, but if the sixth lamp is turned on the circuit is alternately opened and closed until the sixth lamp has been turned off, when the light becomes as steady as before. It resembles a meter in appearance, and can be sealed in a similar manner. The dimensions are: Length, ten inches; width, 7 inches; height, five and one-half inches. The weight is ten pounds packed.

A LARGE ESCALATOR CONTRACT.

The Otis Elevator Company has recently closed a contract with the Subway Construction Company for an Escalator, or moving stairway, to be installed at the Manhattan Street station of the new rapid transit road. At this point the "subway" crosses the Manhattan Valley on a viaduct, the tracks being about forty feet above the level of the street. The Escalator will carry passengers both up and down, the two tracks being arranged in the same vertical plane. The guaranteed carrying capacity of the device is 20,000 people per hour, 10,000 in each direction. A motor of thirty-five horsepower will be sufficient to operate the mechanism when working at its maximum capacity.

RENOLD SILENT CHAIN SALES.

Recent sales of Renold Silent Chain by the Link-Belt Eegineering Company include nine line shaft drives from motors for the new works of the Patton Paint Company, Newark, N. J.; eight drives from motors to line shafts and elevators in the new model plant which the Crompton & Knowles Loom Works are erecting in Philadephia, and eight sixty-horsepower drives for induced-draft blowers in the new Waterside Station of the New York Edison Company. There are now sixty-one Renold Silent Chains in use in the new building of R. H. Macy & Co., varying in capacity from one to ninety horsepower.

AN ATTRACTIVE PUBLICATION.

The Electric Storage Battery Company, of Philadelphia, manufacturers of the Chloride Accumulator, has published for distribution at the Street Railway Convention a booklet entitled "A Few Illustrations Selected from 220 Installations of the 'Chloride Accumulator' Operated in Street Railway Service." A brief preface stating the increase in installations of the Chloride Accumulator from October 1, 1901, to October 1, 1902, is followed by eleven half-tone illustrations of the interiors of several battery houses, with a brief synopsis of the different installations made for the railway companies represented.

The Browning Engineering Company, of Cleveland, Ohio, has recently purchased from the Westinghouse Electric and Manufacturing Company a large number of railway type crane motors, ranging in capacity from twenty-five to fifty horsepower.

A NEW WESTINGHOUSE INSTALLATION.

The Goodall Worsted Company, of Sanford, Maine, is building a large addition to its present works, and has found it necessary to considerably enlarge the power plant. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a 400-kilowatt two-phase alternating current generator, which will be belted to an 800 horsepower Brown engine. The generator will furnish power to all departments of the plant by means of Westinghouse induction motors, and will also provide current through transformers for lighting at 104 volts.

A MAGAZINE THIRTY YEARS OLD.

The Christmas (December) number of *The Delineator* is also the thirtieth anniversary number. The book contains over 230 pages, with 34 full-page illustrations, of which 20 are in two or more colors. The magnitude of this December number, for which 728 tons of paper and six tons of ink have been used, may be understood from the fact that 91 presses running 14 hours a day, have been required to print it; the binding alone of the edition of 915,000 copies representing over 20,000,000 sections which had to be gathered individually by human hands.

DIXON'S GRAPHITE PIPE JOINT COMPOUND.

There is perhaps no better economy to the steamfitter and the engineer than a perfectly tight joint, yet one that can be easily taken apart if desired. It is possible to have such joints if Dixon's Graphite Pipe Joint Compound is used. Flake graphite is impervious to the action of heat or cold, acids or alkalies. Hence the value of a graphite compound when properly prepared. The Joseph Dixon Crucible Company, of Jersey City, N. J., will send booklet and sample free of charge.

AMERICAN MACHINERY IN EUROPE.

American electrical apparatus is making remarkable progress in European markets. The Societe Anonyme Westinghouse has found it necessary on account of the great number of orders to make extensive additions to its plant, which has been in operation for only five years. The plant is located at Havre, France, and supplies the territory included in Holland, Belgium, Italy, Switzerland, Spain, France and their colonies and protectorates.

A LARGE ELEVATOR CONTRACT.

The Otis Elevator Company has recently received the contract for the elevator and dumb-waiter equipment of the new Astor Hotel, Long Acre Square, 44th to 45th Streets, New York. The plant consists of seven electric passenger elevators, two electric servants' elevators, eleven electric dumb-waiters, and three electric sidewalk lifts. Messrs. Clinton & Russell are the architects, and John Downey the general contractor.

The Steel Storage and Elevator Construction Company has adopted electric power distribution for a large grain elevator which will be erected for the Canadian Pacific Railway at Fort William, Ontario. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a direct current generator and a number of direct current motors for the operation of this elevator.

An injunction has been issued against J. F. Buchanan, of Philadelphia, on October 14, 1902, in a suit filed by the General Electric Company on the Tournier patent, No. 559,232, April 28, 1896, the particular infringement being the sale by Buchanan of certain Edison lamp sockets manufactured by the New England Electric Manufacturing Company, of Boston, Mass.

The Stanley Electric Manufacturing Company has recently opened a sales office in Atlanta, Georgia, to take care of the increasing demand for S. K. C. apparatus in the South. The office is in the Empire Building, and is in charge of Mr. George P. Hardy.

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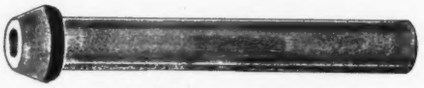

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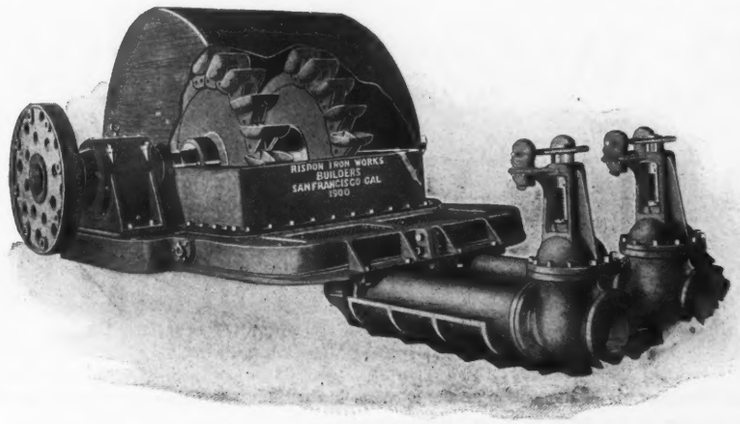

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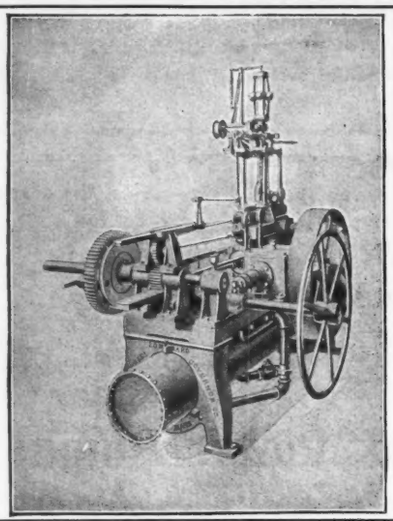

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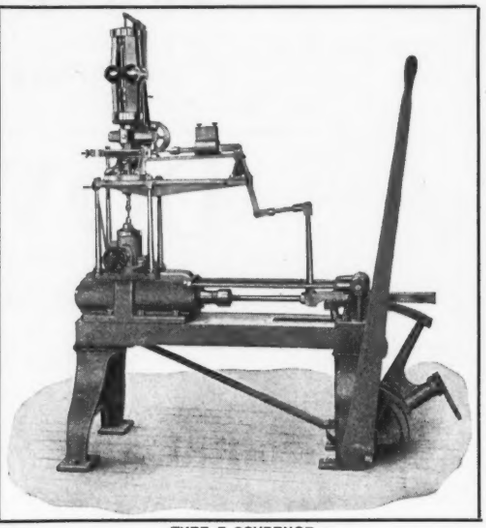

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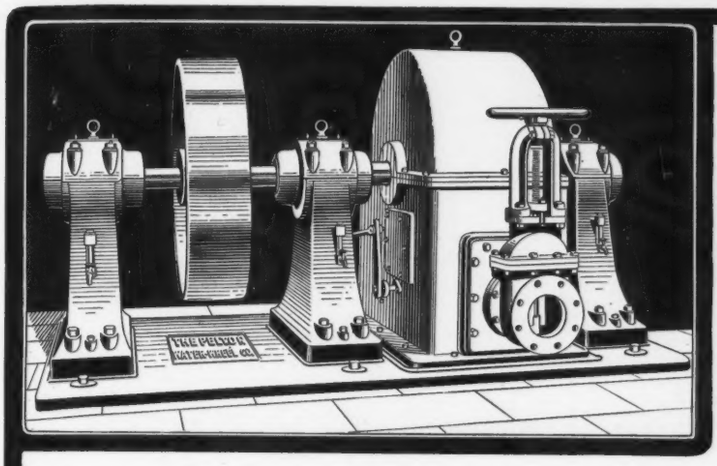

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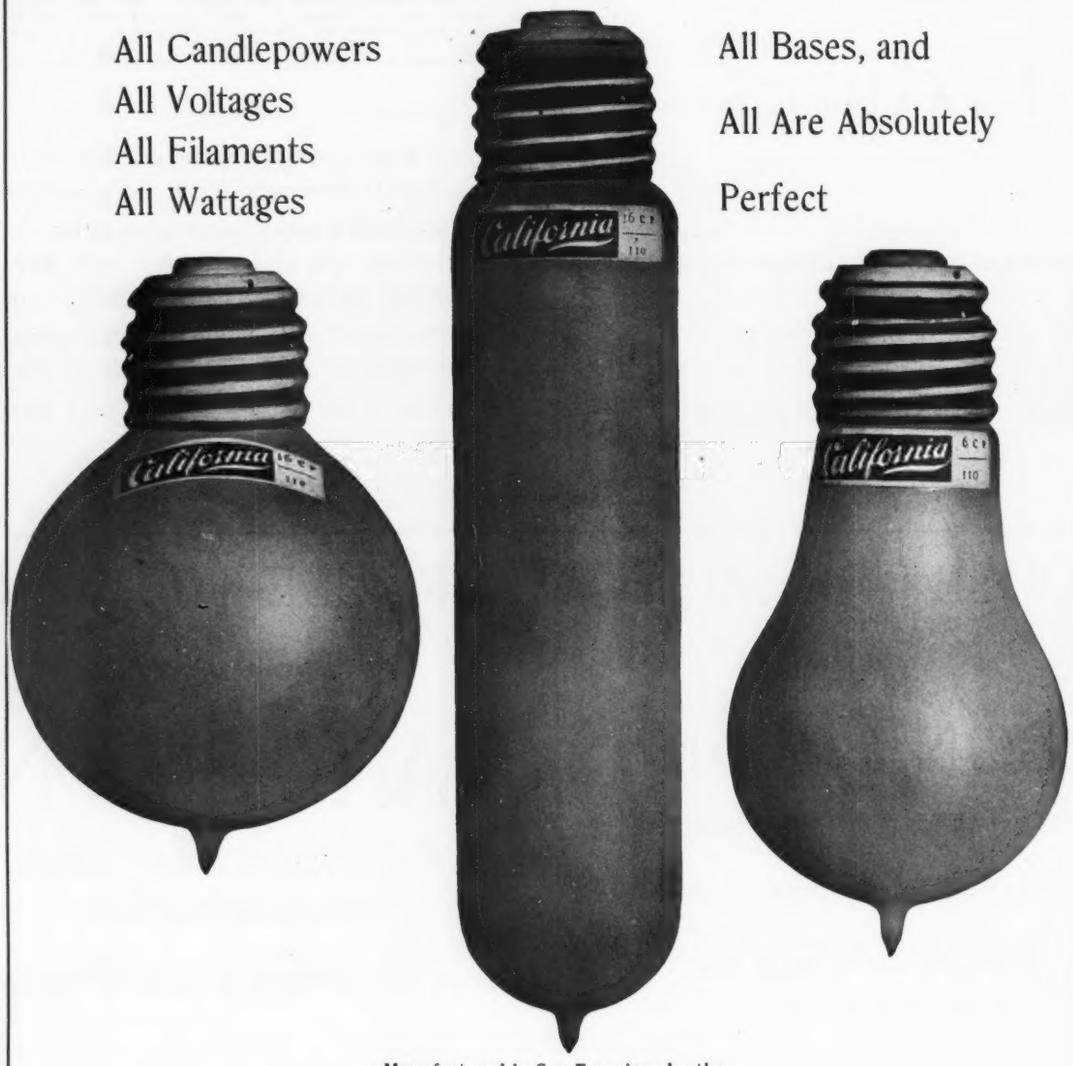

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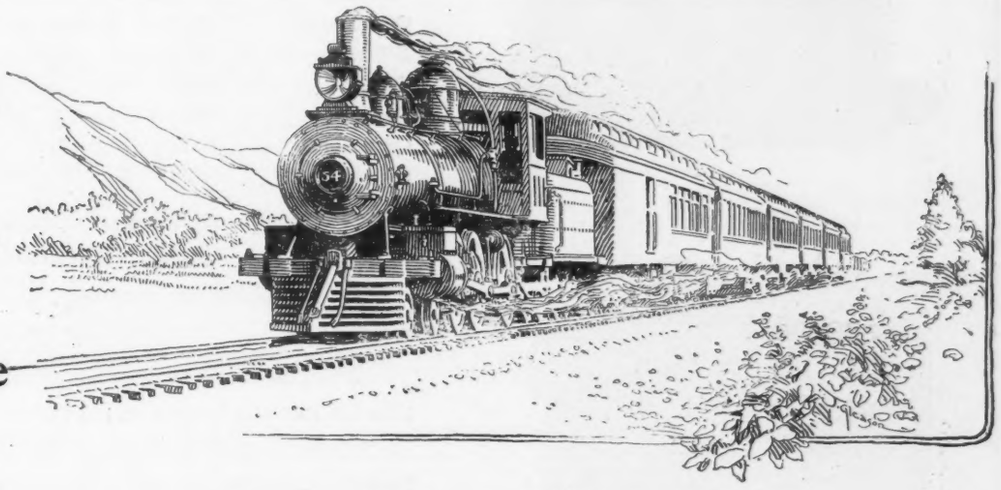

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ADVERTISERS' INDEX.

	PAGE
Akron Smoking Pipe Co	x
Allen, Wyatt H	v
American Circular Loom Co	x
American Electric and Automobile Patents Monthly	vi
American Steel and Wire Company	i
American Telephone Journal	iv
An Alternating Current Calculating Device	vii
Baum, F. G	v
Benjamin, Edward H	v
Bossert Electric Construction Co., The	x
Brooks-Follis Electric Corporation	xv
Byron Jackson Machine Works	vii
California Automatic Telephone Company	ix
California Electrical Works	xviii
California Incandescent Lamp Co	xvi
Carter, & Co., George E	iii
Century Electric Co	v
Cobb, Edward S	v
Cole, John R	x
Cory, C. L	v
Crouse-Hinds Electric Co	xix
Crouse-Tremain	xv
Cutter Co., The	x
Dearborn Drug and Chemical Works	iv
Doble, Robert McF	v
Dow, Geo. E., Pumping Engine Company	xi
Electrical Engineering Co	v
Electric Storage Battery Co	iii
Engineering Offices	v
Fry, Donald H	v
General Electric Company	i
Half Tone Co., The	iii
Hall, Leon M	v
Hardwood Planing Mill Co	vii
Heald's School of Engineering	v
Hemingray Insulators	xix
Hunt, A. M	v
Joseph Dixon Crucible Co	vii
Keystone Law and Patent Co	vii
Knight & Co	vi
Knowles, C. S	iv
Le Mois Scientifique Industriel	xv
Locke, Fred M	vii
Lombard Governor Co	xii
Martin & Co., Jno	ii, vii, viii, xii, xx
Masson, R. S	v
Medina, Frank P	v
Meese & Gottfried Co	i
Meredith, Wynn	v
Moore & Co., Chas. C	iii
National Conduit and Cable Co	x
New York Insulated Wire Co., The	x
Northern Electrical Mfg. Co	ii
Oakland Iron Works	iii
Okonite Company, Ltd., The	i
Otis Elevator Company	ix
Paraffine Paint Company, The	vii
Partridge, John	vi
Pass & Seymour	xix
Pelton Water Wheel Company	xiii
Pittsburgh Reduction Company	viii
Reger, P. A	v
Ridley, A. E. Brooke	xiii
Risdon Iron Works	xi
Roebling's Sons Co, John A	iv
Santa Fe Railway Company	xvii
Sloane Company, The Chas. F	xix
Smith, W. Stuart	v
Southern Pacific Railroad Company	xiii
Spencer, M. D	v
Spon & Chamberlain	v
Standard Electrical Construction Co	v
Stanley Electric Manufacturing Co	xx
Stanley Instrument Co	v
The Journal of Electricity, Power and Gas	vi, xiv
Thomas Day Co	xv
Turner, C. L	v
Union Lumber Company	v
Van der Naillen School of Electricity	v
Van Emon Engineering Company	xvii
Wagner-Bullock Electric Co	vi
Wakefield, G. F	v
Westinghouse, Church, Kerr & Co	viii
Westinghouse Electric & Manufacturing Co	viii
Westinghouse Machine Co	viii
Weston Electrical Instrument Co	i
Worthington, Henry R	xii

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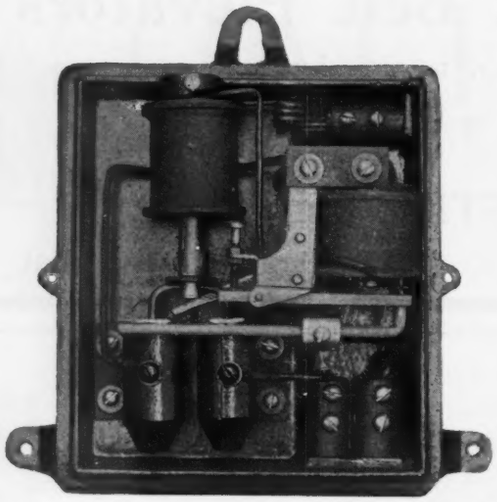

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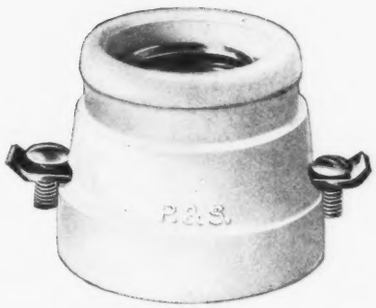

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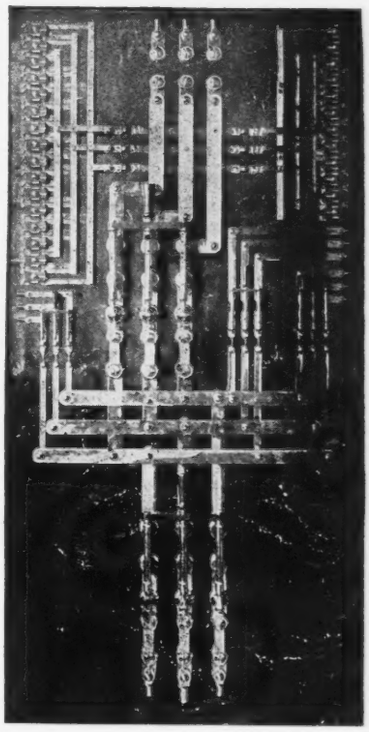

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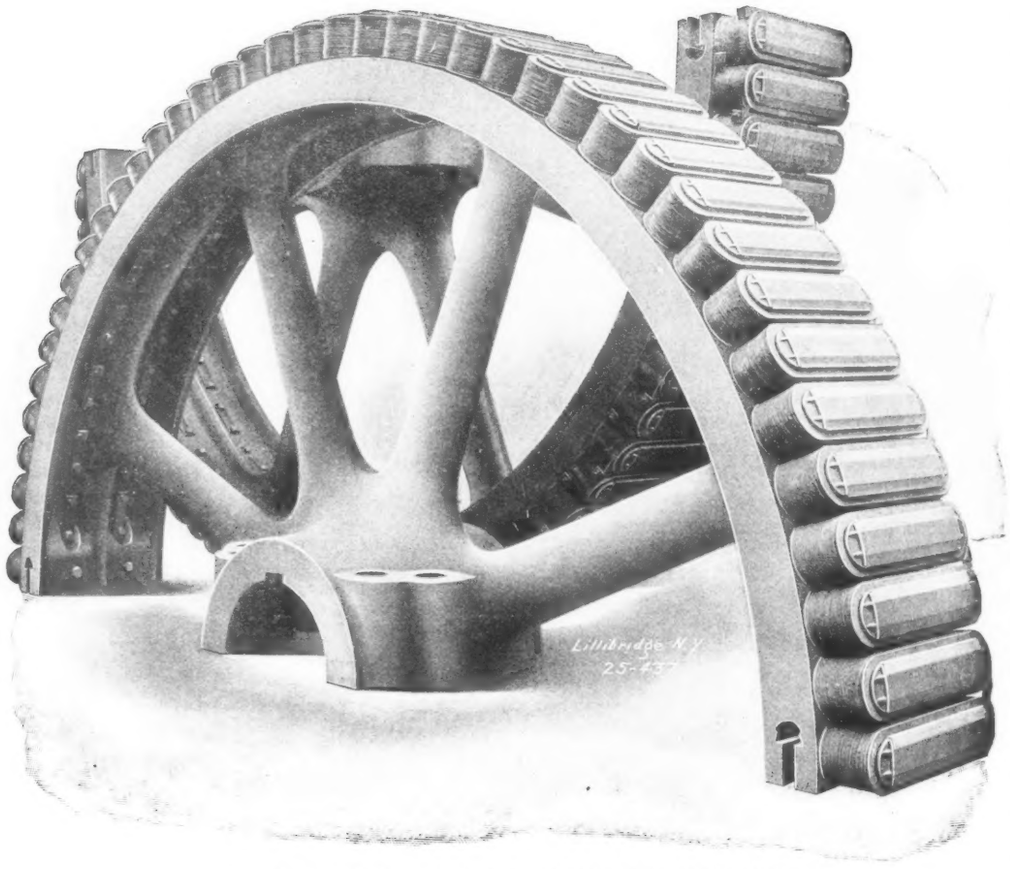

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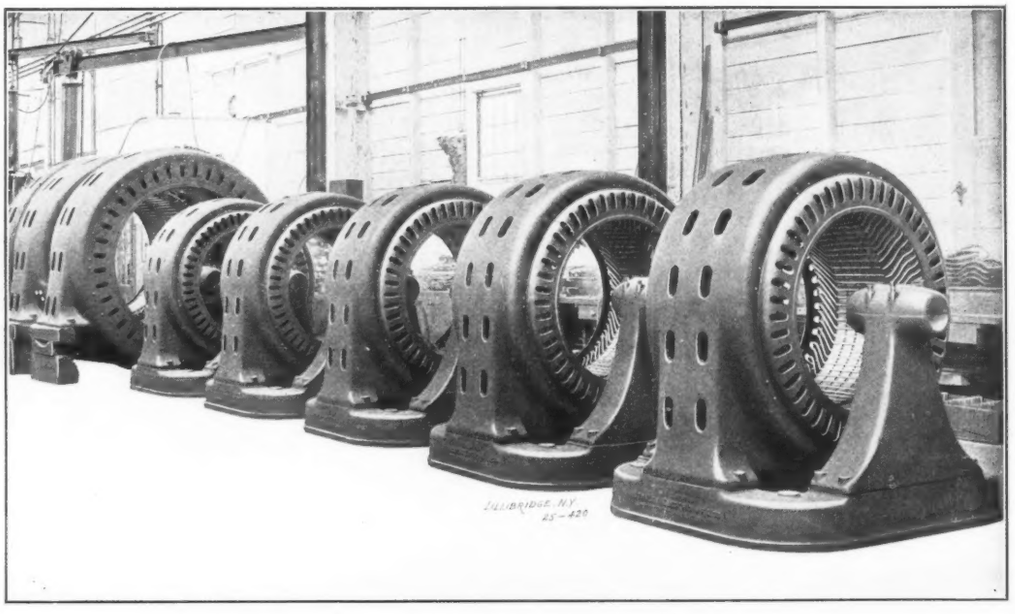

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